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Erosion Potential of Reclaimed Agricultural Lands in Perry County

Greater Egypt Regional Planning and Development Commission, Carbondale, IL

Prepared for

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Areawide Water Quality Management Planning

Erosion Potential of Reclaimed Agricultural Lands in Perry County

Franklin, Gallatin, Hamilton, Hardin, Jackson, Jefferson, Perry, Pope, Saline, and Williamson Counties, Illinois

GREATER EGYPT REGIONAL PLANNING & DEVELOPMENT COMMISSION

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Thirteen hundred acres of land reclaimed by four coal mining companies to row crop capability were assigned soil loss estimates using the Universal Soil Loss Equation. On-site measurements were made. Some areas were in crop production. Tables were prepared to show which of nine hypothetical crop rotation/tillage method combinations would bring each of the 44 acres studied into compliance with Perry County, Illinois erosion control standards for 1995. The report concluded that sediment and erosion control within tolerance limits for reclaimed soils are achievable using common, state of the art management practices.

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July, 1982

Mr. John H. Murray, Chairman
Greater Egypt Regional Planning
and Development Commission

Mr. Herman Adkerson, Chairman
Southeastern Illinois Regional Planning
and Development Commission

Transmitted herewith is the report Erosion Potential of Reclaimed Agricultural Lands in Perry County. This document evaluates the erosion potential of areas totaling 1,300 acres that have been reclaimed under Rule 1104 of the Illinois Surface-Mined Land Conservation and Reclamation Act Amendments of 1975. It provides guidance regarding crop rotations and tillage procedures that will help keep erosion from reclaimed soils in compliance with future county erosion control standards.

This report is a part of the continuing planning process associated with the Areawide Waste Treatment and Water Quality Management Plan for Southern Illinois. It has been prepared to meet the contract requirements of Federal Grant P00-5623-010 with the United States Environmental Protection Agency.

We trust this report will contribute to the implementation of plan objectives for improved water quality in Southern Illinois.

Sincerely,

A. S. Kirkikis
Executive Director

ASK/md

Enclosure

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INTRODUCTION

The Illinois State Erosion and Sediment Control Guidelines adopted April 18, 1980 require soil and water conservation districts to adopt a District Program and Standards for sediment and erosion control.[1] The standards are to specify limits of soil erosion as goals to be reached on lands within the district. The goals are to become progressively more stringent until all land subject to the Sediment and Erosion Control Act experiences an estimated soil loss not exceeding tolerance level for each soil type as specified by the Soil Conservation Service Technical Guide. The guidelines specify that the Universal Soil Loss Equation be used to estimate soil loss. The ultimate state goal is for all agricultural lands to reach tolerance levels or less estimated soil loss by the year 2000. Individual counties are free to establish more stringent standards. Lands showing an estimated soil loss average beyond tolerance levels through a crop rotation sequence are to be considered out of compliance with county standards.

The Perry County Soil and Water Conservation District Board working with its Advisory Committee has completed work on its District Standards. These standards were presented at public hearings in August, 1981. The ultimate goal of the Perry County Program and Standards is to have no agricultural lands in the county experience a soil loss in excess of tolerance level after January 1, 1995.[2] Meeting these goals may pose unique problems in coal producing agricultural counties where surface mining methods are used. Thirty-nine percent of Perry County is underlain with currently surface mineable coal reserves. Previous mining has affected 11.3 percent of the county's acreage.[3] Improved methods of surface mining may make it economically feasible to mine even more of the county, since over 80% of the county is underlain with coal.[4] These facts make the nature and success of surface mine reclamation a matter of great importance to Perry County since the vast majority of the county's acreage is capable of supporting row crop agriculture.

Reclamation laws now require the establishment of a rooting medium, grading to approximately the original slope and restoration of top soil to the surface. The resumption of cropping activities will be possible on lands reclaimed in this manner after coal has been removed. As time passes reclaimed lands will begin to come back into agricultural production. Some of this land will return to private ownership, some will go to corporation farms and some will be retained by mining companies for their use. Newly reclaimed land must meet

Sediment and Erosion Control Standards under state surface mine rules and regulations. If reclaimed lands return to private ownership after bond release, they come under the Voluntary County Sediment and Erosion Control Standards wherein maintenance of compliance-level erosion rates is dependent on the management ability and willingness of the land owner.

Reclaimed areas represent an altered landscape and an altered soil. The potential erosion rate of these lands is unknown. It is not known if the standards set for sediment and erosion control in the county will be realistic for reclaimed lands or how reclaimed soils may compare to the general agricultural lands of the county when soil losses are calculated for checks of compliance with county standards. The current project is designed to give some answers to those questions using the preliminary conclusions of soil scientists, measurements of slope made on areas reclaimed to row crop capability, and special applications of the universal soil loss equation. The major objective of this project is to determine if lands reclaimed under current state reclamation laws will be capable of meeting standards set by the Perry County Soil and Water Conservation District and to determine what, if any, special treatment may be necessary to bring such lands into compliance while being used for agricultural production. As sub-objectives it is hoped that, (1) the interested public will be better informed regarding the erosion potential and management needs of reclaimed lands and (2) that agricultural and mining interests will initiate cooperative efforts directed at management of reclaimed lands within the limits of County Sediment and Erosion Control Standards when they are returned to agricultural production.

This is a pilot program expected to provide a basis for similar work in other coal producing counties. While results in terms of the data collected would be expected to differ from county to county it is expected that the methods developed for this study are transferable.

Conscious effort has been made in this project to minimize the cost in man hours and travel expenses so that such a study can be brought within reach of soil and water conservation district budgets. Time expenditure has totaled approximately six man-months. In Perry County there have been the advantages of an intensive soil survey in progress, a keen interest on the part of district board members in the effects of surface mining and its implications for the future of agriculture, and the helpful cooperation of all four mining companies operating in the county.

Reclamation laws in Illinois have evolved from the Open Cut Land Relcamation Act of 1962 which required grading to strike off ridge tops plus revegetation to the Surface-Mined Land Conservation and Reclamation Act amendments of 1975. The 1975 Act required replacement of top soil over a suitable root medium to a total depth of at least four feet on lands suitable for row crop agriculture. Grading to approximately the original contours was also required (See Appendix A for a summary of Illinois surface mining laws and their requirements).

The Surface-Mined Land Conservation and Reclamation Act of 1971 with its amendments of 1975 and 1977 provides for a review of surface mining permit applications by county boards. In Southern Illinois most county boards seek soil and water conservation district board input in the review process. The Perry County Soil and Water Conservation District has been very active in this process from its beginning. A major concern of the District Board has been that the procedures required by Rule 1104 of the Surface-Mined Land Conservation and Reclamation Act Rules and Regulations be successfully carried out by coal mining companies. These rules and regulations became effective March 18, 1976. They require that land "capable of being reclaimed for row-crop agriculture purposes and suitable for row-crop agriculture purposes based on United States Soil Conservation Service Soil Survey classifications of affected land prior to mining shall be graded to the approximate original grade of the land and all or part of the darkened surface soil...be segregated during the stripping process and replaced as a final cover..."[5]

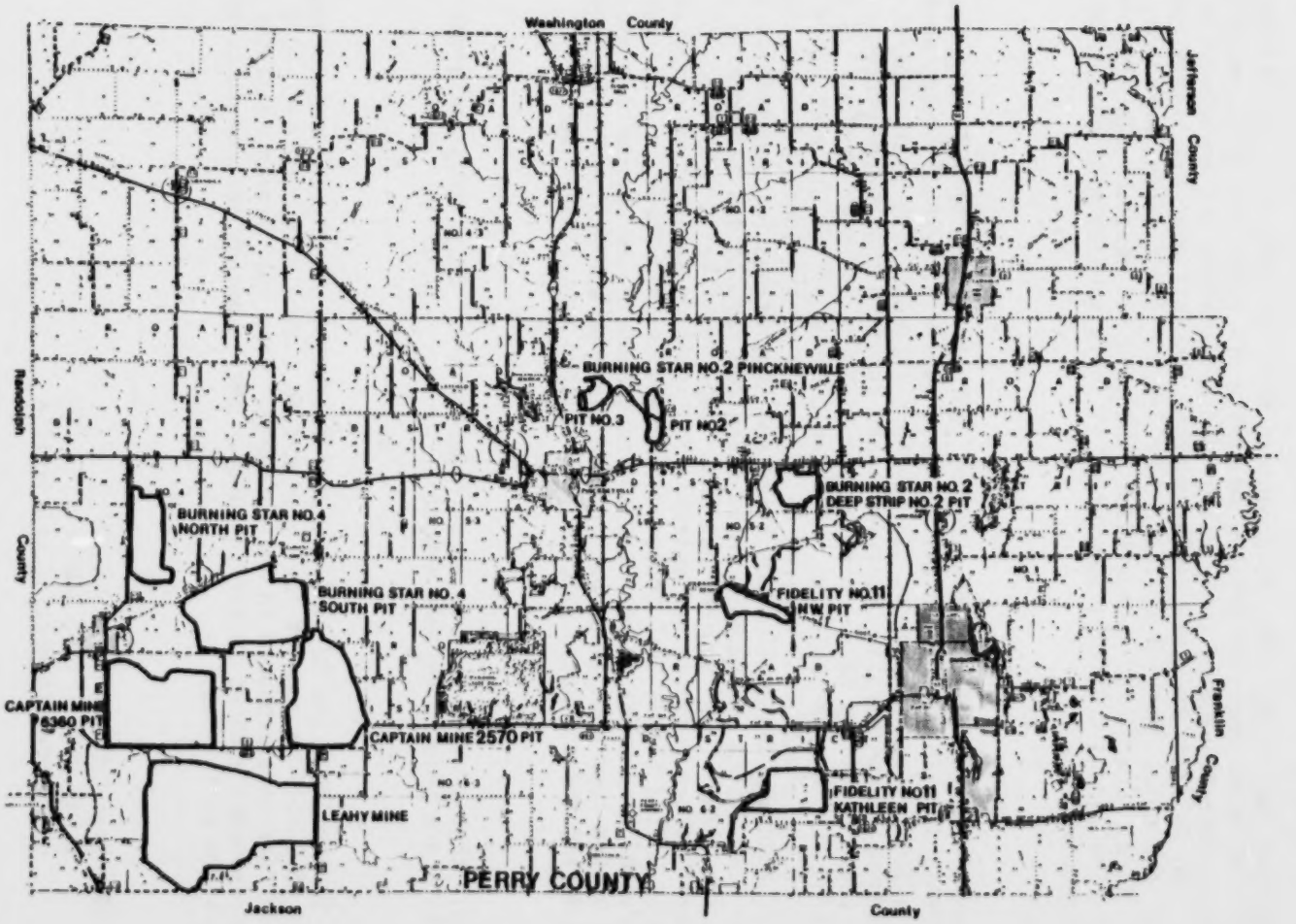
The full text of this rule appears in Appendix A. Only lands reclaimed under Rule 1104 are covered in this report.

Perry County leads the 22 Illinois coal producing counties in coal production. Of the 62.5 million tons of coal produced in Illinois in 1980 over 10.9 million tons were produced in Perry County.[6] Four coal mining companies currently operate mines in Perry County. The companies and the mines they operate are as follows:

AMAX Coal Company
Leahy Mine - T6S, R4W
One large pit east of Willisville

Map 1

CURRENT SURFACE MINING OPERATIONS HAVING AREAS RECLAIMED UNDER RULE 1104



Consolidation Coal Company
Burning Star #2 Mine T5S, R2W
Number 2 Pit east of Pinckneyville
Burning Star #3 Mine - T5S, R2W & R3W
Three pits east of Pinckneyville
Burning Star #4 Mine - T5S, R4E
Two pits north of Jamestown

Freeman United Coal Mining Company

Fidelity #11 Mine - T6S, R2W
Two pits west of DuQuoin

Southwestern Illinois Coal Corporation

Captain Mine - T65, R4W
Two pits southeast of Cutler, near Denmark.

The oldest large scale surface mining operation in Perry County is the Pyramid Mine. This mine was opened in 1925. It was operated by Binkly Coal Company. Truax Traer Coal Company acquired it in 1950. After operations stopped at this mine it was given to Southern Illinois University. Beginning in 1954, the university conducted a research project in fish and wildlife habitat enhancement for about 13 years after which the Old Pyramid Mine and adjoining tracts were given to the State of Illinois and commissioned as a 2,[illegible]7 acre state park.

The first of the current mining operations to begin surface mining for coal in Perry County was Freeman United Coal Mining Company which opened its Fidelity #11 Mine in 1929 about one mile east of the present Perry County Airport.

Truax Traer Coal Company opened the Burning Star #2 Mine near Pinckneyville in 1951. This operation was acquired by Consolidation Coal Company in a 1962 merger.

Southwestern Illinois Coal Corporation opened the Captain Mine near Willisville in 1964. This mine has now expanded north and east to the newer #6360 and #2570 pits.

Consolidation Coal Company opened its Burning Star #4 Mine near Jamestown in 1973 with the south pit. The north pit and deepstrip pit #3 at Burning Star #2 were opened in 1978.

AMAX Coal Company began operations in Perry County with the opening of the Leahy Mine in 1971 south of Denmark. This mine is distinguished by the length of its active pit which is over three miles long.

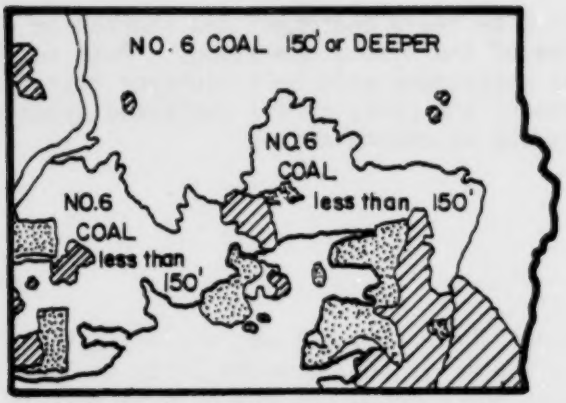
More than 32,000 acres of Perry County have been affected by surface mining for coal.[7] Approximately half of the remaining acreage is underlain with strippable coal reserves in the Harrisburg number 5 and Herrin number 6 coal seams (Map 2).

Of the acres strip mined through 1979, 13,084 acres were mined before there was any requirement by law for reclamation.[8] These areas have been abandoned or converted to wildlife and pasture acres by revegetation with trees and grass. The abandoned lands are characterized by steep, rocky slopes; water filled pits and denuded, toxic areas. In contrast, lands reclaimed since 1977 have been graded to approximate the premining contours of the landscape. Top soil replacement has occurred on a total acreage somewhat less than the acreage devoted to row crops in the surface mined areas before they were mined. For this report 1,300 acres of restored land were studied and estimates made of its potential soil loss under specific cropping regimes and tillage practices after reclamation. Probable soil loss potential under premining conditions was also estimated for much of the acreage covered in the study.

The effects of mining procedures on top soil have been a concern since before top soil segregation and replacement were required by law. A 1974 study in Knox County compared plant growth and crop yield between top soiled and mixed soil areas.[9] More recent work has given attention to the effects on bulk density and soil microbiota.[10] These studies have generally concluded that heavy machinery traffic increases bulk density (thus decreasing soil moisture permeability) and that stockpiling for extended periods of time causes a loss of soil fertility. The conclusions have indirect implications for erodibility in that both reduced percolation and reduced organic material in the soil can result in increased erodibility.

In Perry County mines, overburden removal is accomplished by a variety of methods. Shovels, draglines and wheel excavators are all in use. Methods

Map 2

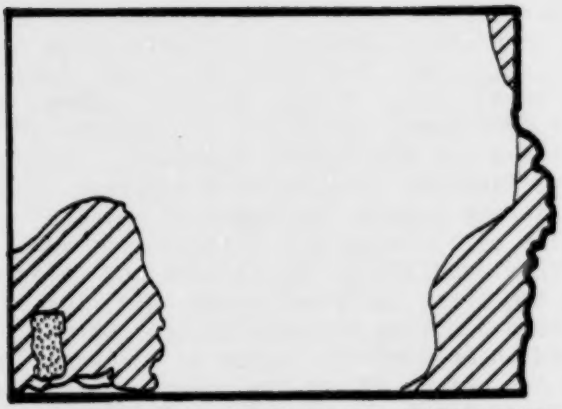


HERRIN NO. 6 COAL DEPOSITS

SURFACE MINED AREAS

UNDERGROUND MINED AREAS

PERRY COUNTY



HARRISBURG NO.5 COAL DEPOSITS
(28" to 60" thick)

NO. 5 COAL REMOVED BY SURFACE MINING

NO. 5 COAL RESERVED

PERRY COUNTY

which reduce handling by heavy equipment and shorten or eliminate stockpiling are employed by some of the mining operations. Most notable of these would be the use of wheel excavators with belt conveyor transfer or distribution. However, in this report the soils in all reclaimed areas are given the same USLE factors regardless of mining method.

Reclaimed Soils

In surface mined areas where top soil was not replaced, soils were once classified in Perry County as 801B Orthent silty or 802B Orthent loamy soils on 1-5 percent slopes and as 802C Orthent on 5-15 percent slopes. These soils were classified as 803E Orthent loamy skeletal on 15-30 percent slopes and on 25-60 percent slopes as 803F. Under current classification these soils without original top soil are placed in the Lenzberg and Morristown soil series in surface mined areas of Southern Illinois.[11] When areas began to be reclaimed with segregation and replacement of top soil, new soil descriptions had to be worked out.

Work by USDA-SCS soil scientists engaged in a detailed soil survey of Perry County led to the proposal of two new soil series for reclaimed surface mined areas with top soil replaced. The proposed new series were necessary because the breakup and mixing of top soil in the process of overburden removal resulted in a soil with characteristics differing from the series found in the original soil association. The Cisne, Hoyleton, Tamalco, Wynose, Bluford, Ava, Wagner, Okaw, Hurst, Colp, Karnak, Blair, Hickory, Belknap, Bonnie and Sharon soils were sufficiently altered by the process of removal, transport and spreading to make a new description necessary. Samples of reclaimed soils from Perry and Randolph Counties were separated into two proposed series by the soil survey team on the basis of physical characteristics. Testing at University of Illinois soil laboratories verified the proposed series and established erodibility (K) factors and tolerance (T) factors for them. As a result the areas reclaimed under Rule 1104 in Perry County were placed in the proposed Schuline or Swanwick Soil Series. Both of these series were assigned an erodibility factor of .37 and a tolerance factor of five tons per acre per year. All of the areas studied for this report were reclaimed with restored top soil, therefore, these preliminary factors were used in data development for this report. They represent the best current information and are likely to be the same or very nearly the same as the final assigned factors. The Preliminary Review Draft describing the Schuline Series follows:

Schuline Series (823)
K = .37
T = 5.0

The Schuline Series consists of deep, well drained soils formed in graded, textured material or cast overburden from surface mining. The regolith consists of a mixture of five earth materials and generally has some till pebbles and a few fragments of limestone, siltstone, and sandstone. In some places, top soil material has been placed on the surface. Slopes range from 0 to 15 percent. Permeability is moderately slow or slow. Mean annual temperature is about 55 degrees F. and mean annual precipitation is about 40 inches.

Taxonomic Class: Fine-loamy, mixed (non-acid), mesic; Typic Orthent.[12]

Swanwick Series
K = .37
T = 5.0

The Swanwick Series consists of deep, moderately well drained soils on uplands. Permeability is very slow or slow. These soils have been reconstructed from the overburden of surface mining. The regolith consists of a mixture of pre-mined soil and fine earth material, and has less than 10 percent by volume of till pebbles, and small fragments of limestone, sandstone, shale, and coal. Most areas of these soils have more than 10 inches of topsoil placed on the surface. Slopes range from 0 to 10 percent. Mean annual temperature is about 53 degrees F. and mean annual precipitation is about 40 inches.

Taxonomic Class: Fine-silty, mixed (non-acid), mesic; Typic Orthent.[13]

METHODS

Study areas for the evaluation of erosion potential were selected on the basis of the stage of reclamation reached in the 1981 growing season. Areas reclaimed beginning in 1978 to October 1981 which had been top soiled, leveled and seeded were used in the study. Since reclamation is an ongoing process several hundred acres were added to the inventory of study areas while the data gathering work was in progress. The areas covered in this report should include all Rule 1104 land in Perry County fully reclaimed to at least the stage of first seeding of cover during the 1981 growing season. Thus a four-year span of reclamation effort is represented.

Reclamation maps or recent aerial photos were prepared by reclamation personnel of each mining company to show outlines of the areas reclaimed or being reclaimed under Rule 1104 in each of the mines. These or tracings from them were used in field measurement activities and as a source for maps appearing in this report. Study areas were separated from each other on the basis of: (1) actual physical separation, (2) difference in time since reclamation was completed and (3) non-uniformity of slope characteristics. Each area was assigned a letter and number designation so that information appearing on data tables could be associated with the corresponding map areas.

Soil loss estimates were made using the universal soil loss equation, (USLE). This is the standard method specified in the Illinois Sediment and Erosion Control Act as the basis for establishment of compliance or non-compliance in connection with sediment and erosion complaints. The factors which go into the USLE are: the rainfall factor (R); the erosion characteristics of the specific soil series or association (K); a factor derived from length and steepness of slope (LS); the combined protective effect of vegetative cover on the soil (C); and the conservation practices carried out by those who prepare or maintain the land for use (P). These factors are further explained in Appendix B.

The K and LS factors were derived in different ways for premining and postmining soil loss estimates. This was necessitated by the lack of premining slope length information and the differing sources of soils information. The derivation of USLE factors, as applied in pre and postmining soil loss estimates can be summarized as follows:

R Factor - This factor has been developed for regions of the state by the Department of Agriculture from U.S. Weather Bureau data. For Perry County this factor is set at 220.

K Factor - This value is assigned to each soil series as an index of erodibility. For premining soil loss calculations a map of soil associations or a soil survey map was superimposed on an equal scale map of each Rule 1104 reclaimed area and the areal percentage of each soil type or association obtained by planimetry. For soil associations a composite K value was developed from K values for each soil type in the association based upon the percentage of each soil type in the association. These percentages were obtained from existing soil association descriptions. By this method a single K value was derived to represent each 1104 reclaimed area (See Appendix C, page 64). For postmining soil loss calculations a K value of F.37 was used based upon the draft description of the proposed Schuline and Swanwick Soil Series prepared by the Perry County Soil Survey Team and verified at University of Illinois laboratories.

LS Factor - This factor was derived from a standard soil loss ratio (LS) table as published in the Land Use and Management Systems Technical Guide Section III-I using averages of percent slope and slope length for each Rule 1104 reclaimed area. For premining soil loss calculations contour maps were the only source for slope information. Average percent slope and slope length were obtained by measuring distance between contour lines in a representative sampling of the slope characteristics of each 1104 reclaimed area as it was before mining. For postmining soil loss calculations the LS factor was derived from the averages of on-site slope and slope length measurements made during field visits to each 1104 reclaimed area. The number of actual measurements made varied with the size and degree of slope uniformity of each area.

C Factor - Values for C Factor were chosen for each of eight land use categories as follows:

Premining Cropland:

1965 to 1971 - 0.17, based on a general crop rotation of corn-soybeans-grain-meadow with conventional tillage and spring plowing.

1973 to 1978 - 0.28, based on a corn-soybean-grain (with catch crop) rotation conventional till, spring plow residue left part of the time.

Postmining Cropland:

To calculate soil loss on Rule 1104 areas as they now are, C factors were taken from Tables found in standard USLE manuals, (Appendix D) based upon cover type and percent seen during field visits. Individual crops were given the following C values - soybeans - 0.48, corn - 0.36, milo - 0.36 and sunflowers - 0.41. For the hypothetical cropping sequences used in postmining soil loss estimates the following C Factor values were selected from Table B-3 (Appendix B):

Crop Sequence	Tillage	C Factor
Corn-Soybeans	Spring plow conventional -	0.57
	Chisel Plant System	0.25
	No Till	0.10
Corn-Soybeans-grain + Catch Crop	Spring plow conventional	0.26
	Chisel Plant System	0.18
	No Till	0.097
Corn-Soybeans-Grain -meadow	Spring plow conventional	0.14
	Chisel Plant System	0.14
	No Till	0.067

Premining Pasture, Grassland or Idleland:

C Factor values were based on Table B-4 (Appendix B). If aerial photos were not definitive, 0.013 was used.

Postmining Pasture, Grassland or Idle land:

C Factor values were based on Table B-4 (Appendix B), and percent cover as judged during field visits to Rule 1104 reclaimed areas.

Premining Woodland:

If woodlands were associated with pasture, they were considered disturbed. The nature of canopy and understory were judged from aerial photographs; and C values derived from Tables B-4 or B-5, (Appendix B). If no definitive aerials were available a C Factor value of 0.084 was used.

Postmining Woodland:

No tree plantings on Rule 1104 reclaimed land were old enough to fit this category. Vineyards were judged as an understory for apparent percent coverage and nature of ground cover.

Residential:

Farmsteads were put in this category and assigned a C Factor value of 0.003.

Water:

Water acreage was excluded from the total acreage of an area when calculating a composite C Factor value.

P Factor:

Conservation practices could not be accurately evaluated for premining soil loss calculations. Because of this a P Factor value of 1.0 was used for both pre and postmining except where terraces were present or being installed. Tillage-related practices were reflected in C Factor values.

Because of the differences in method between pre and postmining for obtaining LS Factor values, the premining and postmining soil loss estimates could not be considered fully comparable. To help evaluate the degree to which comparisons can be accepted, both methods for obtaining percent slope and slope length averages were carried out on a Rule 1104 reclaimed area for which postmining contour mapping has been completed. The percent slope and slope length averages obtained were lower when contour lines were used (2.4% and 238 ft.) than those obtained from field measurements (3.3% and 365 ft.) resulting in a 26% difference in LS factor.

Hypothetical crop rotations chosen for use with postmining soil loss estimates were suggested by the Perry County Soil and Water Conservation District. They were meant to reflect crop sequences in common use in the county and other sequences that retain the cash crop plantings but have elements that create a reduced long range soil loss. Once R, K, and LS factors have been established a larger variety of crop rotations and tillage practices can be fed into the USLE using information found in the tables in Appendix B.

T Factor:

Tolerance factors for the various soils were averaged according to the percent of each area occupied by each soil association or type. For premining data development, the procedure was the same as for calculation of a composite K factor for each area. (See table of composite K and T values for Perry County Soil Association in Appendix B, page 64). For postmining data development a T value of 5.0 tons per acre per year was assigned since this is the value given by soil scientists to the proposed Schuline and Swanwick Soil Series.

RESULTS

Information obtained during field visits to the mined areas reclaimed under Rule 1104 was vital to the calculation of postmining soil loss estimates. This information included percent slope and slope length measurements from which an LS factor could be assigned to each area by extrapolation from the Soil Loss Ratio Chart (Appendix B), and information concerning the type and percentage of current cover. Final decisions about the delineation of areas were also made in these visits. Acreages for each area were measured by planimeter directly on aerial photos or tracings of aerial photos of the areas. Field data and acreage for each Rule 1104 reclaimed area is as follows:

Mine	Area	Acreage	Slope Averages Percent	Length	Plant Cover & Surface
Burning Star #2	B2-A	31	3.8	370	Grasses - (90% cover)
	B2-B	23	2.0	540	Wheat, soybeans, sorghum
	B2-C	67	2.9	524	Grass, legumes, tree seedlings
	B2-D	50	1.3	500	Natural herbaceous growth (idle land)
	B2-E	32	1.7	338	Corn
	B2-F	45	3.3	285	Grass-legume (90% cover)
	B2-G	78	2.2	278	Grass, legume
	B2-2	17	4.0	127	Grass, legume (95% cover)
	B2-3A	28	4.8	130	Wheat, then regraded
	B2-3B	23	5.3	150	Wheat, then regraded
Burning Star #4	B4-A	103	5.8	123	Wheat, legume (80% cover)
	B4-B	17	4.0	200	Wheat, legume (95% cover)
	B4-C	65	2.9	163	Wheat, legume (95% cover)
	B4-D	41	2.4	165	67% grass, legume; 33% graded
	B4-E	43	3.5	132	New grass/legume seeding, terraced
Captain Mine	63-A	99	3.3	365	Alfalfa, sudex (50% new seeding)

Mine	Area	Acreage	Slope Averages Percent	Length	Plant Cover & Surface
	63-B	42	1.9	437	Corn, soybean, grain
	63-C	24	3.1	260	Alfalfa, (90% cover)
	63-D	27	2.9	220	Grass, trees, grape, corn, soybeans
	25-A	41	2.1	288	Sudex, alfalfa, (new seeding)
	25-B	77	2.6	433	Alfalfa (90% cover)
	25-C	28	2.1	361	Alfalfa (new seeding)
Fidelity #11	F11-A	3	2.8	148	Heavy grass/legume cover
	F11-B	9	3.8	168	Heavy grass/legume cover
	F11-C	29	3.2	150	Heavy weed/legume cover
	F11-D	61	3.7	182	27% corn, 19% soybeans, 54% wheat
	F11-E	43	3.0	471	Wheat, hay & newly seeded areas
	F11-F	79	0.8	775	New wheat/legume seeding
	F11-G	45	1.1	415	New wheat/legume seeding
	F11-H	24	3.3	271	Milo, some gullying
Leahy Mine	L1-A	19	1.9	652	Hay, weeds
	L1-B	25	2.1	727	Sunflowers, corn idle
	L-2	24	1.0	950	Idle land
	L3-A	18	1.5	400	Corn & idle
	L3-B	12	1.5	650	Idle land
	L-4	10	1.0	750	Idle land
	L5-A	7	1.5	825	Idle land
	L5-B	3	0.5	650	Grass, legume
	L5-C	11	1.5	600	Idle land
	L-6	12	1.6	690	Alfalfa, weeds
	L-7	7	2.0	175	Alfalfa (90% cover)
	L-8	11	2.3	400	Alfalfa (80% cover)
	L9-A	4	4.0	195	Idle land
	L9-B	10	2.9	388	Grasses (95% cover)

*Slope lengths in feet

The percent slope average and average slope length figures given above were used to obtain an LS factor for each of the Rule 1104 reclaimed areas. Vegetative cover information was used to determine a C factor for use in determining a current soil loss estimate. Each area was located on a reclamation plan map or current aerial photograph. These maps or aerial photos were redrawn at a

1' = 1600 feet scale for this report. A map of each mine pit follows which shows the location of each Rule 1104 area used in this study. Following each map are tables which show post reclamation soil loss estimates for the areas as they are and as they would be with nine different hypothetical combinations of crop rotation and tillage.

The following is a key to the symbols used in USLE Data for Reclaimed Areas:

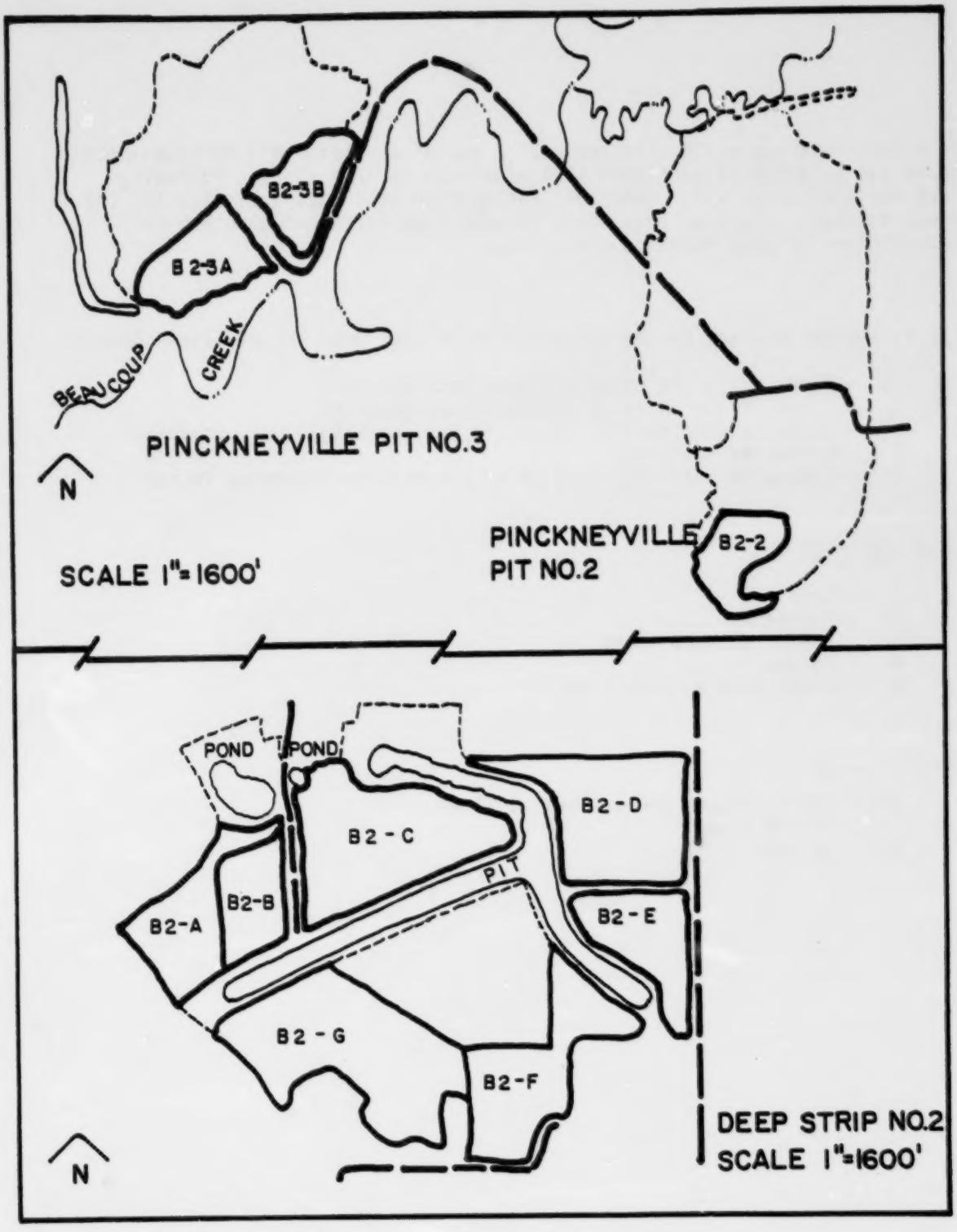
LS - Slope factor in Universal Soil Loss Equation
C - Cover factor in Universal Soil Loss Equation
P - Conservation practice factor in Universal Soil Loss Equation
E - Estimated soil loss
E/T - Estimated soil loss divided by the erosion tolerance factor

Under Rotation

C - Corn
Sb - Soybeans
G - Grain, such as wheat
M - Meadow
Gx - Grain with a catch crop

Under Tillage

SPC - Spring plowed conventional tillage
CP - Chisel plowed
NT - No till



Map 3

BURNING STAR NO.2 MINE

USLE DATA FOR BURNING STAR #2
DEEP STRIP #2

Constant USLE Factors -- R = 220
K = .37

Area	Slope Averages Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
B2-A	3.8	370'	.60	C-SB	SPC	.51	0.5	12.5	2.5T
					CP	.25	0.5	6.1	1.2T
					NT	.10	1.0	4.8	1.0T
				C-SB-Gx	SPC	.26	0.5	6.3	1.3T
					CP	.18	0.5	4.4	0.9T
					NT	.097	1.0	4.8	1.0T
				C-SB-G-M	SPC	.14	0.5	3.4	0.7T
					CP	.14	0.5	3.4	0.7T
					NT	.067	1.0	3.2	0.6T
Cover currently present or 1981 seeding						.013	0.5	0.3	0.06T
B2-B	2.0	540'	.33	C-SB	SPC	.51	1.0	13.7	2.7T
					CP	.25	1.0	6.7	1.3T
					NT	.10	1.0	2.7	0.5T
				C-SB-Gx	SPC	.26	1.0	7.0	1.4T
					CP	.18	1.0	4.8	1.0T
					NT	.097	1.0	2.6	0.5T
				C-SB-G-M	SPC	.14	1.0	3.8	0.8T
					CP	.14	1.0	3.8	0.8T
					NT	.067	1.0	1.8	0.4T
Cover currently present or 1981 seeding									
B2-C	2.9	524'	.47	C-SB	SPC	.51	0.9	17.6	3.5T
					CP	.25	0.9	8.6	1.7T
					NT	.10	0.9	3.4	0.7T
				C-SB-Gx	SPC	.26	0.9	9.0	1.8T
					CP	.18	0.9	6.2	1.2T
					NT	.097	0.9	3.3	0.7T
				C-SB-G-M	SPC	.14	0.9	5.4	1.1T
					CP	.14	0.9	5.4	1.1T
					NT	.067	0.9	2.3	0.5T
Cover currently present or 1981 seeding						.013	0.9	0.5	0.1T

Area	Slope Averages Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
B2-D	1.3	500'	.24	C-SB	SPC	.51	1.0	10.0	2.0T
					CP	.25	1.0	4.9	1.0T
					NT	.10	1.0	2.0	0.4T
				C-SB-Gx	SPC	.26	1.0	5.1	1.0T
					CP	.18	1.0	3.5	0.7T
					NT	.097	1.0	1.9	0.4T
				C-SB-G-M	SPC	.14	1.0	2.7	0.5T
					CP	.14	1.0	2.7	0.5T
					NT	.067	1.0	1.3	0.3T
Cover currently present or 1981 seeding						.043	1.0	0.8	0.2T
B2-E	1.7	338'	.26	C-SB	SPC	.51	1.0	10.8	2.2T
					CP	.25	1.0	5.3	1.1T
					NT	.10	1.0	2.1	0.4T
				C-SB	SPC	.26	1.0	5.5	1.1T
					CP	.18	1.0	3.8	0.8T
					NT	.097	1.0	2.1	0.4T
				C-SB-G-M	SPC	.14	1.0	3.0	0.6T
					CP	.14	1.0	3.0	0.6T
					NT	.067	1.0	1.4	0.3T
Cover currently present or 1981 seeding						.36	1.0	7.6	1.5T
B2-F	3.3	283'	.45	C-SB	SPC	.51	1.0	18.7	3.7T
					CP	.25	1.0	9.2	1.8T
					NT	.10	1.0	3.7	0.7T
				C-SB-Gx	SPC	.26	1.0	9.5	1.9T
					CP	.18	1.0	6.6	1.3T
					NT	.097	1.0	3.6	0.7T
				C-SB-G-M	SPC	.14	1.0	5.1	1.0T
					CP	.14	1.0	5.1	1.0T
					NT	.067	1.0	2.5	0.5T
Cover currently present or 1981 seeding						.36	1.0	0.5	0.1T
B2-G	2.2	278'	.29	C-SB	SPC	.51	0.5	6.0	1.2T
					CP	.25	0.5	2.9	0.6T
					NT	.10	1.0	2.4	0.5T
				C-SB-Gx	SPC	.26	0.5	3.1	0.6T
					CP	.18	0.5	2.1	0.4T
					NT	.097	1.0	2.2	0.4T
				C-SB-G-M	SPC	.14	0.5	1.7	0.3T
					CP	.14	0.5	1.7	0.3T
					NT	.067	1.0	1.6	0.3T
Cover currently present or 1981 seeding						.013	0.5	0.2	0.4T

PINCKNEYVILLE PIT #2

Constant USLE Factors -- R = 220
K = .37

Area	Slope Averages Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
B2-2	4.0	127'	.44	C-SB	SPC	.51	0.5	9.1	1.8T
					CP	.25	0.5	4.5	0.9T
					NT	.10	1.0	3.6	0.7T
				C-SB-Gx	SPC	.26	0.5	4.7	0.9T
					CP	.18	0.5	3.2	0.6T
					NT	.097	1.0	3.4	0.7T
				C-SB-G-M	SPC	.14	0.5	2.5	0.5T
					CP	.14	0.5	2.5	0.5T
					NT	.067	1.0	2.4	0.5T
Cover currently present or 1981 seeding						.003	0.5	0.1	0.02T

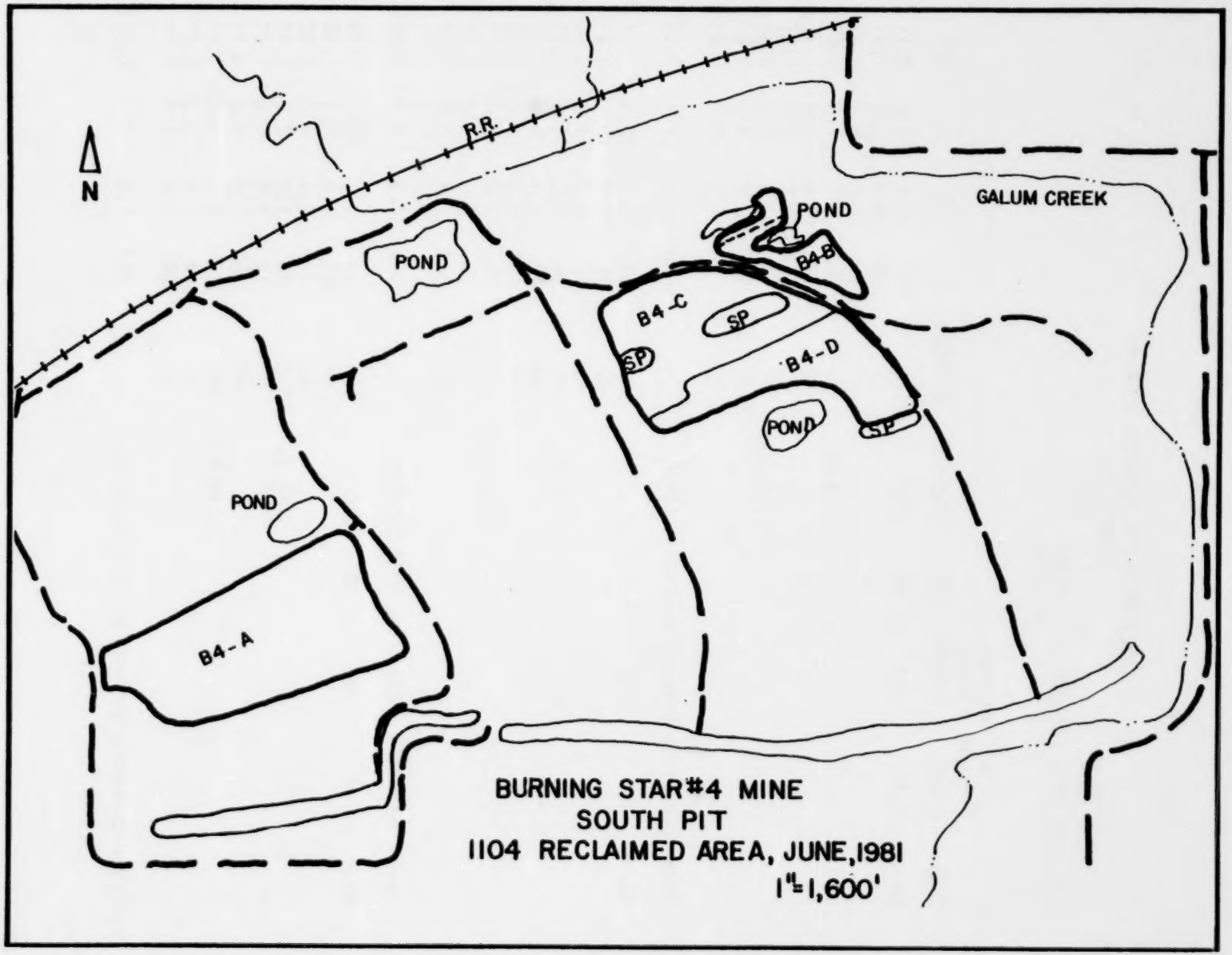
PINCKNEYVILLE PIT #3

Area	Slope Averages Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
B2-3A	4.8	130'	.58	C-SB	SPC	.51	0.5	12.0	2.4T
					CP	.25	0.5	5.9	1.2T
					NT	.10	1.0	4.8	1.0T
				C-SB-Gx	SPC	.26	0.5	6.1	1.2T
					CP	.18	0.5	4.2	0.8T
					NT	.097	1.0	4.6	0.9T
				C-SB-G-M	SPC	.14	0.5	3.3	0.7T
					CP	.14	0.5	3.3	0.7T
					NT	.067	1.0	3.2	0.6T
Cover currently present or 1981 seeding						.042	0.5	1.0	1.2T
B2-3B	5.3	150'	.71	C-SB	SPC	.51	0.5	14.7	2.9T
					CP	.25	0.5	7.2	1.4T
					NT	.10	1.0	5.8	1.2T
				C-SB-Gx	SPC	.26	0.5	7.5	1.5T
					CP	.18	0.5	5.2	1.0T
					NT	.097	1.0	5.6	1.1T

Area	Slope Averages Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
				C-SB-G-M	SPC	.14	0.5	4.0	0.8T
					CP	.14	0.5	4.0	0.8T
					NT	.067	1.0	3.8	0.8T
Cover currently present or 1981 seeding						.042	0.5	1.2	0.2T

Source: Data compiled by Greater Egypt Regional Planning and Development Commission staff

Map 4


N
R.R.
POND
POND
GALUM CREEK
B4-B
B4-C
SP
SP
B4-D
POND
SP
POND
B4-A
BURNING STAR #4 MINE
SOUTH PIT
1104 RECLAIMED AREA, JUNE, 1981
1"=1,600'

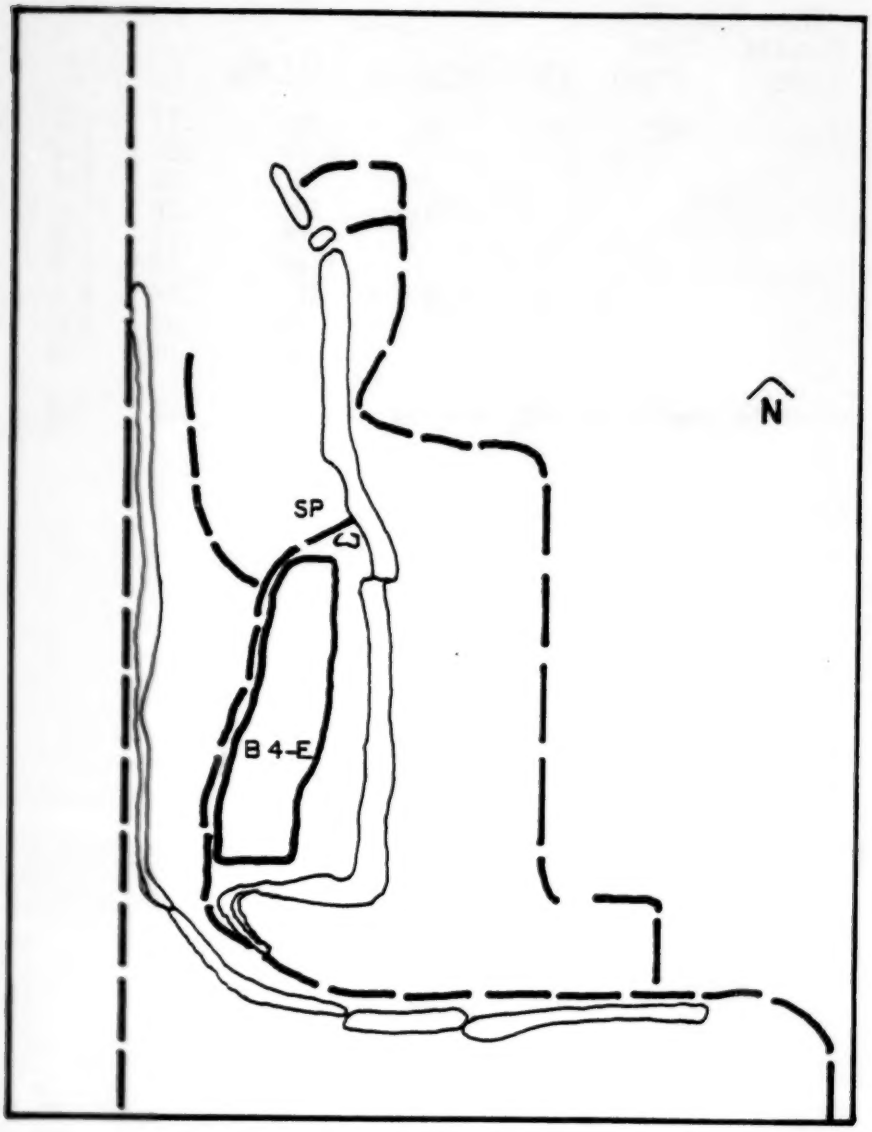
USLE DATA FOR BURNING STAR #4
SOUTH PIT

Constant USLE Factors -- R = 220
K = .37

Area	Slope Averages: Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
B4-A	5.8	122'	.74	C-SB	SPC	.51	0.5	15.4	3.1T
					CP	.25	0.5	7.5	1.5T
					NT	.10	1.0	6.0	1.2T
				C-SB-Gx	SPC	.26	0.5	7.8	1.6T
					CP	.18	0.5	5.4	1.1T
					NT	.097	1.0	5.8	1.2T
				C-SB-G-M	SPC	.14	0.5	4.2	0.8T
					CP	.14	0.5	4.2	0.8T
					NT	.067	1.0	4.0	0.8T
Cover currently present or 1981 seeding						.013	0.5	0.4	0.08T
B4-B	4.0	200'	.53	C-S	SPC	.51	1.0	22.0	4.4T
					CP	.25	1.0	10.8	2.2T
					NT	.10	1.0	4.3	0.9T
				C-SB-Gx	SPC	.26	1.0	11.2	2.2T
					CP	.18	1.0	7.8	1.6T
					NT	.097	1.0	4.2	0.8T
				C-SB-G-M	SPC	.14	1.0	6.0	1.2T
					CP	.14	1.0	6.0	1.2T
					NT	.067	1.0	2.9	0.6T
Cover currently present or 1981 seeding						.003	1.0	0.1	0.02T
B4-C	2.9	163'	.33	C-S	SPC	.51	1.0	13.7	2.7T
					CP	.25	1.0	6.7	1.3T
					NT	.10	1.0	2.7	0.5T
				C-SB-Gx	SPC	.26	1.0	7.0	1.4T
					CP	.18	1.0	4.8	1.0T
					NT	.097	1.0	2.6	0.5T
				C-SB-G-M	SPC	.14	1.0	3.8	0.8T
					CP	.14	1.0	3.8	0.8T
					NT	.067	1.0	1.8	0.4T
Cover currently present or 1981 seeding						.003	1.0	0.1	0.02T

Area	Slope Averages Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
B4-D	2.4	165'	.28	C-SB	SPC	.51	1.0	11.6	2.3T
					CP	.25	1.0	5.7	1.1T
					NT	.10	1.0	2.3	0.5T
				C-SB-Gx	SPC	.26	1.0	5.9	1.2T
					CP	.18	1.0	4.1	0.8T
					NT	.097	1.0	2.2	0.4T
				C-SB-G-M	SPC	.14	1.0	3.2	0.6T
					CP	.14	1.0	3.2	0.6T
					NT	.067	1.0	1.5	0.3T
Cover currently present or 1981 seeding						.02	1.0	0.5	0.1T

Map 5



BURNING STAR # 4
NORTH PIT

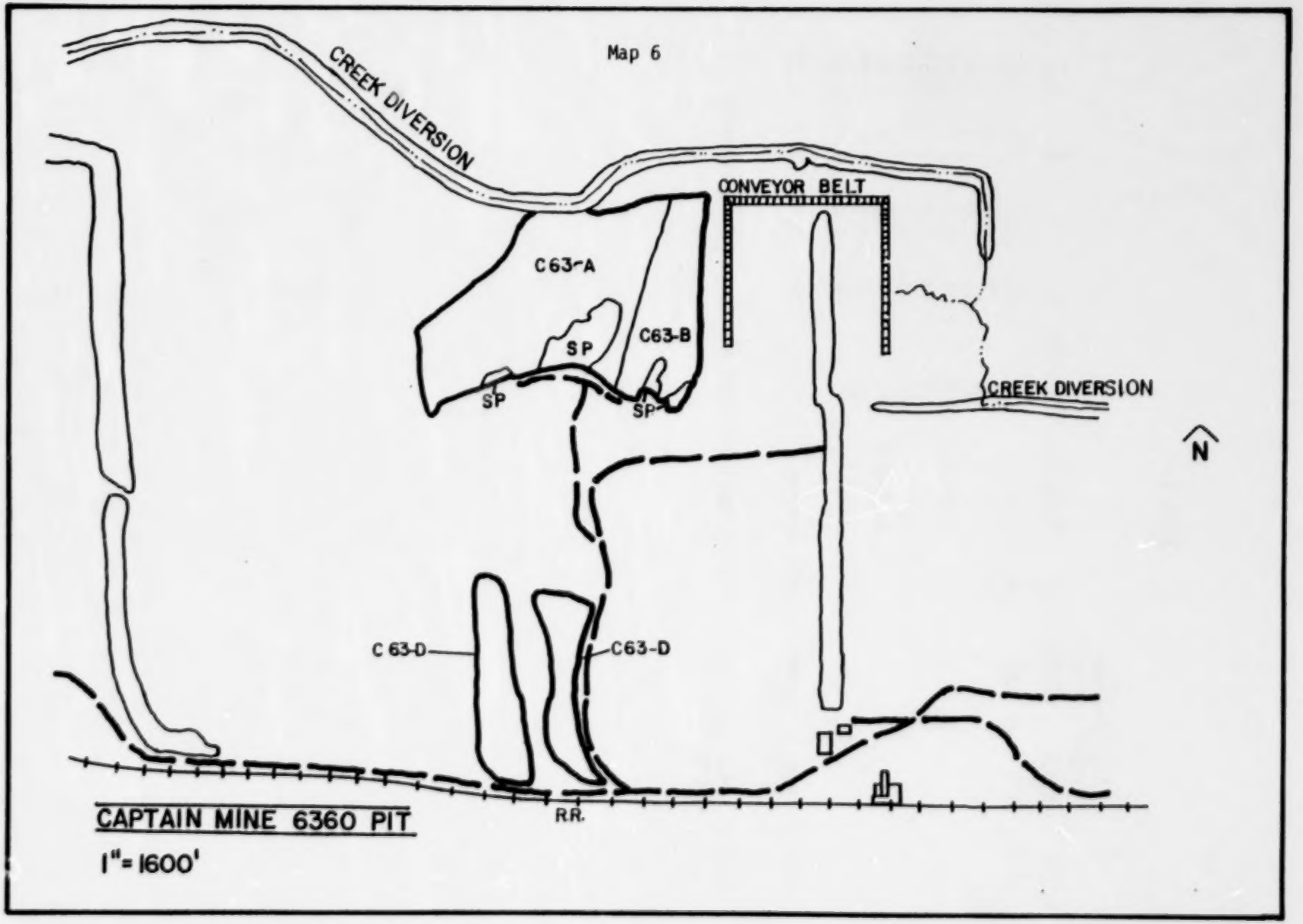
1"=1600'

NORTH PIT

Area	Slope Averages Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
B4-E	3.5	132'	.38	C-SB	SPC	.51	0.5	7.9	1.6T
					CP	.25	0.5	3.9	0.8T
					NT	.10	1.0	3.1	0.6T
				C-SB-Gx	SPC	.26	0.5	4.0	0.8T
					CP	.18	0.5	2.3	0.5T
					NT	.097	1.0	3.0	0.6T
				C-SB-G-M	SPC	.14	0.5	2.2	0.4T
					CP	.14	0.5	2.2	0.4T
					NT	.067	1.0	2.1	0.4T
Cover currently present or 1981 seeding						.042	0.5	1.3	0.3T

Source: Data compiled by Greater Egypt Regional Planning and Development Commission staff

Map 6

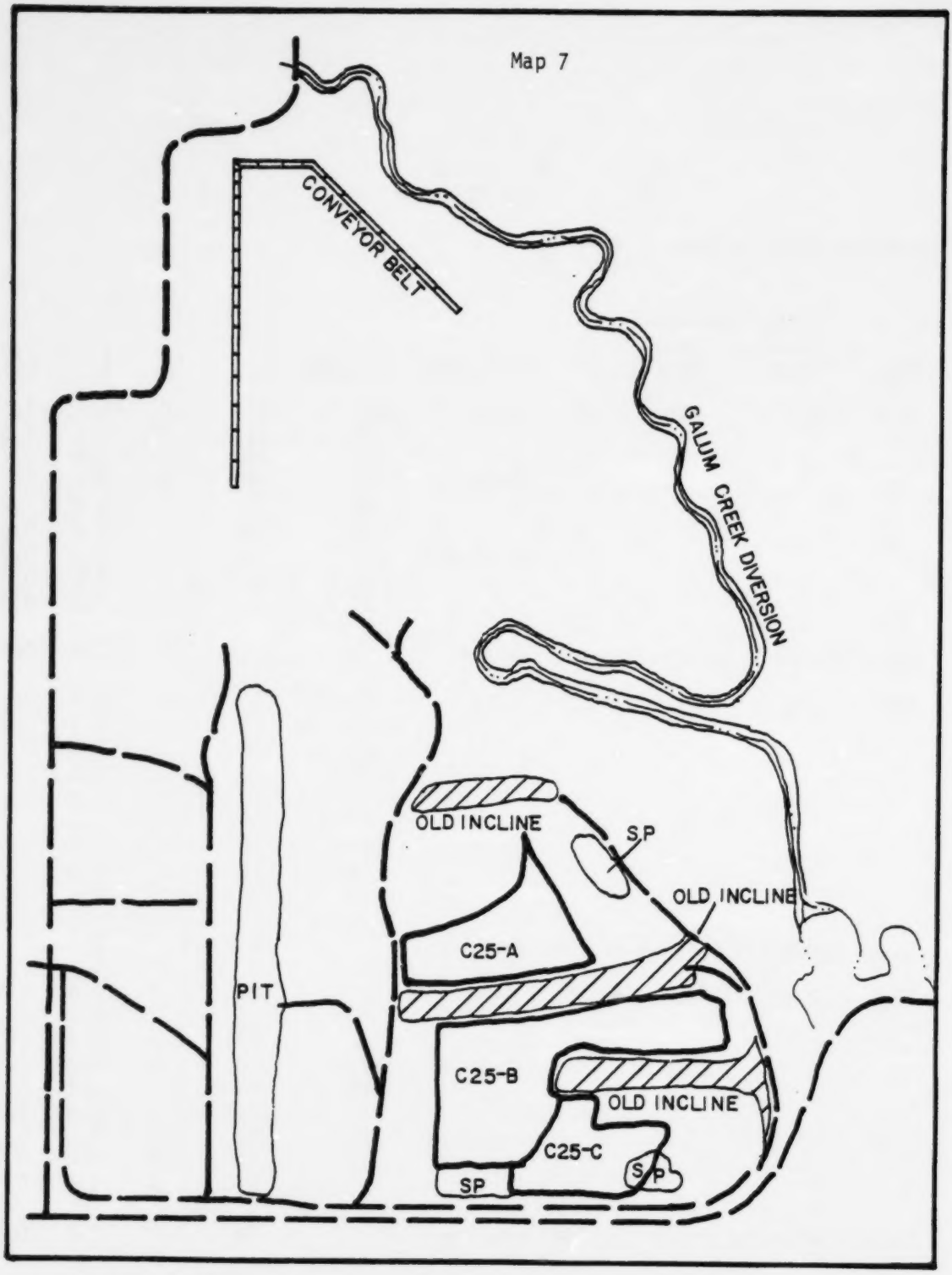

CREEK DIVERSION
CONVEYOR BELT
C63-A
C63-B
SP
SP
SP
CREEK DIVERSION
N
C 63-D
C63-D
R.R.
CAPTAIN MINE 6360 PIT
1"= 1600'

USLE DATA FOR CAPTAIN MINE
6360 PIT

Constant USLE Factors -- R = 220
K = .37

Area	Slope Averages Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
63-A	3.3	365'	.46	C-SB	SPC	.51	0.5	9.5	1.9T
					CP	.25	0.5	4.7	0.9T
					NT	.10	1.0	6.2	1.2T
				C-SB-Gx	SPC	.26	0.5	8.0	1.6T
					CP	.18	0.5	3.4	0.7T
					NT	.097	1.0	6.0	1.2T
				C-SB-G-M	SPC	.14	0.5	4.3	0.9T
					CP	.14	0.5	2.6	0.5T
					NT	.067	1.0	4.2	0.8T
Cover currently present or 1981 seeding						.047	0.5	2.9	0.6T
63-B	1.9	437'	.32	C-SB	SPC	.51	1.0	13.3	2.7T
					CP	.25	1.0	6.5	1.3T
					NT	.10	1.0	2.6	0.5T
				C-SB-Gx	SPC	.26	1.0	6.8	1.4T
					CP	.18	1.0	4.7	0.9T
					NT	.097	1.0	2.5	0.5T
				C-SB-G-M	SPC	.14	1.0	3.6	0.7T
					CP	.14	1.0	3.6	0.7T
					NT	.067	1.0	1.7	0.3T
Cover currently present or 1981 seeding						.097	1.0	2.4	0.5T
63-C	3.1	260'	.39	C-SB	SPC	.51	1.0	16.3	3.2T
					CP	.25	1.0	7.9	3.2T
					NT	.10	1.0	3.2	0.6T
				C-SB-Gx	SPC	.26	1.0	8.3	1.7T
					CP	.18	1.0	5.7	1.1T
					NT	.097	1.0	3.1	0.6T
				C-SB-G-M	SPC	.14	1.0	4.4	0.9T
					CP	.14	1.0	4.4	0.9T
					NT	.067	1.0	2.1	0.4T
Cover currently present or 1981 seeding						.009	1.0	0.3	0.06T

Area	Slope Averages Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
63-D	2.9	220'	.35	C-SB	SPC	.51	1.0	14.5	2.9T
					CP	.25	1.0	7.1	1.4T
					NT	.10	1.0	2.8	0.6T
				C-SB-Gx	SPC	.26	1.0	7.4	1.5T
					CP	.18	1.0	5.1	1.0T
					NT	.097	1.0	2.8	0.6T
				C-SB-G-M	SPC	.14	1.0	4.0	0.8T
					CP	.14	1.0	4.0	0.8T
					NT	.067	1.0	1.9	0.4T
Cover currently present or 1981 seeding						.08	1.0	2.3	0.5T



CAPTAIN MINE 2570 PIT

SCALE: 1"= 1600'

N

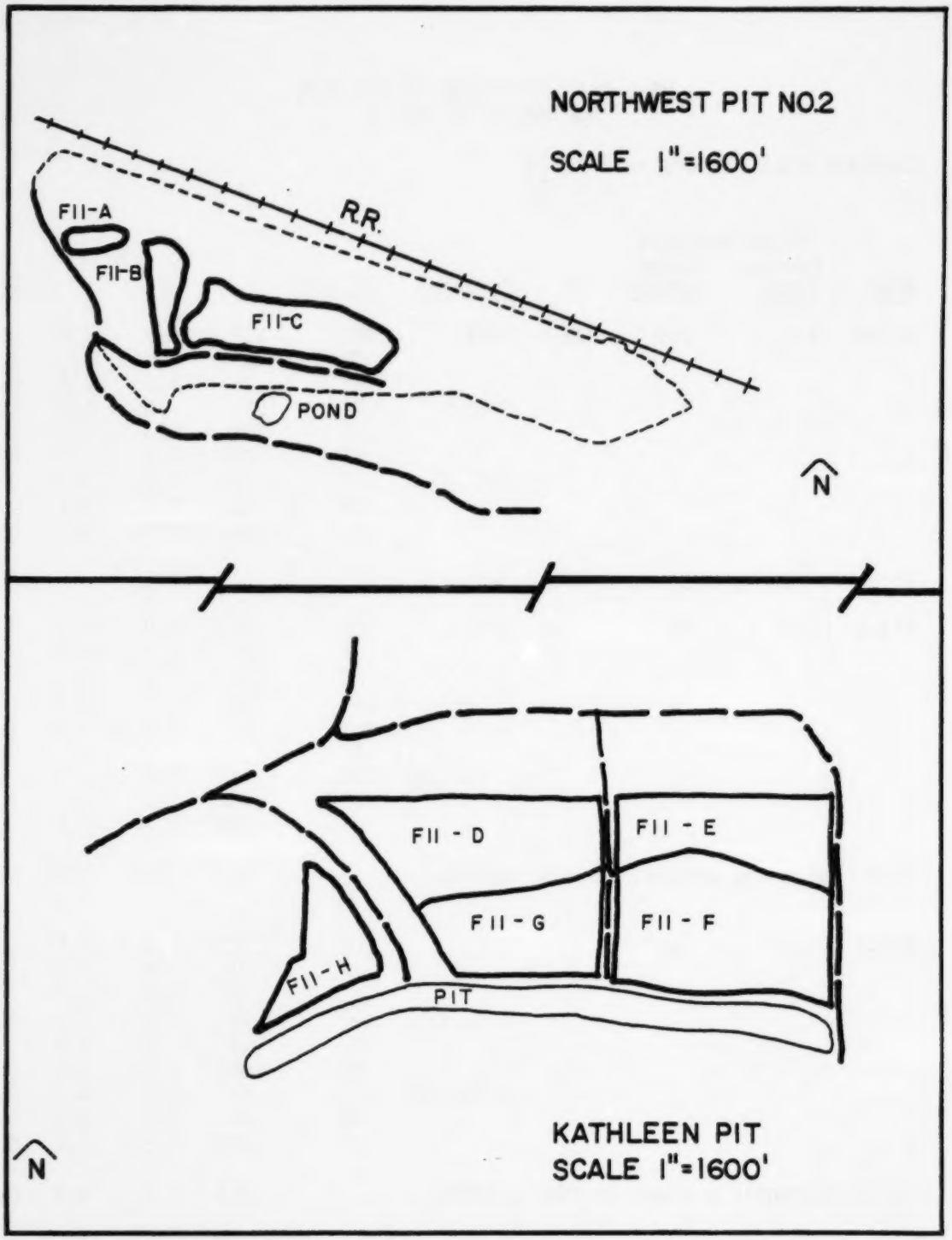
CAPTAIN MINE
2570 PIT

Constant USLE Factors -- R = 220
K = .37

Area	Slope Averages Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
25-A	2.1	288'	.40	C-SB	SPC	.51	1.0	16.6	3.3T
					CP	.25	1.0	8.1	1.6T
					NT	.10	1.0	3.3	0.7T
				C-SB-Gx	SPC	.26	1.0	8.5	1.7T
					CP	.18	1.0	5.9	1.2T
					NT	.097	1.0	3.2	0.6T
				C-SB-G-M	SPC	.14	1.0	4.6	0.9T
					CP	.14	1.0	4.6	0.9T
					NT	.067	1.0	2.2	0.4T
Cover currently present or 1981 seeding						.097	1.0	2.6	0.5T
25B	2.6	433'	.40	C-SB	SPC	.51	1.0	16.6	3.3T
					CP	.25	1.0	8.1	1.6T
					NT	.10	1.0	3.3	0.7T
				C-SB-Gx	SPC	.26	1.0	8.5	1.7T
					CP	.18	1.0	5.9	1.2T
					NT	.097	1.0	3.2	0.6T
				C-SB-G-M	SPC	.14	1.0	4.6	0.9T
					CP	.14	1.0	4.6	0.9T
					NT	.067	1.0	2.2	0.4T
Cover currently present or 1981 seeding						.009	1.0	0.3	0.06T
25-C	2.1	361'	.30	C-SB	SPC	.51	1.0	12.5	2.5T
					CP	.25	1.0	6.1	1.2T
					NT	.10	1.0	2.4	0.5T
				C-SB-Gx	SPC	.26	1.0	6.3	1.3T
					CP	.18	1.0	4.4	0.9T
					NT	.097	1.0	2.4	4.5T
				C-SB-G-M	SPC	.14	1.0	3.4	0.7T
					CP	.14	1.0	3.4	0.7T
					NT	.067	1.0	1.6	0.3T
Cover currently present or 1981 seeding						.10	1.0	2.4	0.5T

Source: Data compiled by Greater Egypt Regional Planning and Development Commission staff

Map 8



FIDELITY #11 MINE

USLE DATA FOR FIDELITY #11 MINE
NORTHWEST PIT NO. 2

Constant USLE Factors -- R = 220
K = .37

Area	Slope Averages Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
Fll-A	2.8	148'	.30	C-SB	SPC	.51	1.0	12.5	2.5T
					CP	.25	1.0	6.1	1.2T
					NT	.10	1.0	2.4	0.5T
				C-SB-Gx	SPC	.26	1.0	6.3	1.3T
					CP	.18	1.0	4.4	0.9T
					NT	.097	1.0	2.4	0.5T
				C-SB-G-M	SPC	.14	1.0	3.4	0.7T
					CP	.14	1.0	3.4	0.7T
					NT	.067	1.0	1.6	0.3T
Cover currently present or 1981 seeding						.02	1.0	0.5	0.1T
Fll-B	3.8	168'	.52	C-SB	SPC	.51	1.0	21.6	4.3T
					CP	.25	1.0	10.6	2.1T
					NT	.10	1.0	4.2	0.8T
				C-SB-Gx	SPC	.26	1.0	11.0	2.2T
					CP	.18	1.0	7.6	1.5T
					NT	.097	1.0	4.1	0.8T
				C-SB-G-M	SPC	.14	1.0	5.9	1.2T
					CP	.14	1.0	5.9	1.2T
					NT	.067	1.0	2.8	0.6T
Cover currently present or 1981 seeding						.011	1.0	0.5	0.1T
Fll-C	3.2	150'	.36	C-SB	SPC	.51	1.0	14.9	3.0T
					CP	.25	1.0	7.3	1.5T
					NT	.10	1.0	2.9	0.6T
				C-SB-Gx	SPC	.26	1.0	7.6	1.5T
					CP	.18	1.0	5.3	1.1T
					NT	.097	1.0	2.8	0.6T
				C-SB-G-M	SPC	.14	1.0	4.1	0.8T
					CP	.14	1.0	4.1	0.8T
					NT	.067	1.0	2.0	0.4T
Cover currently present or 1981 seeding						.011	1.0	0.3	0.06T

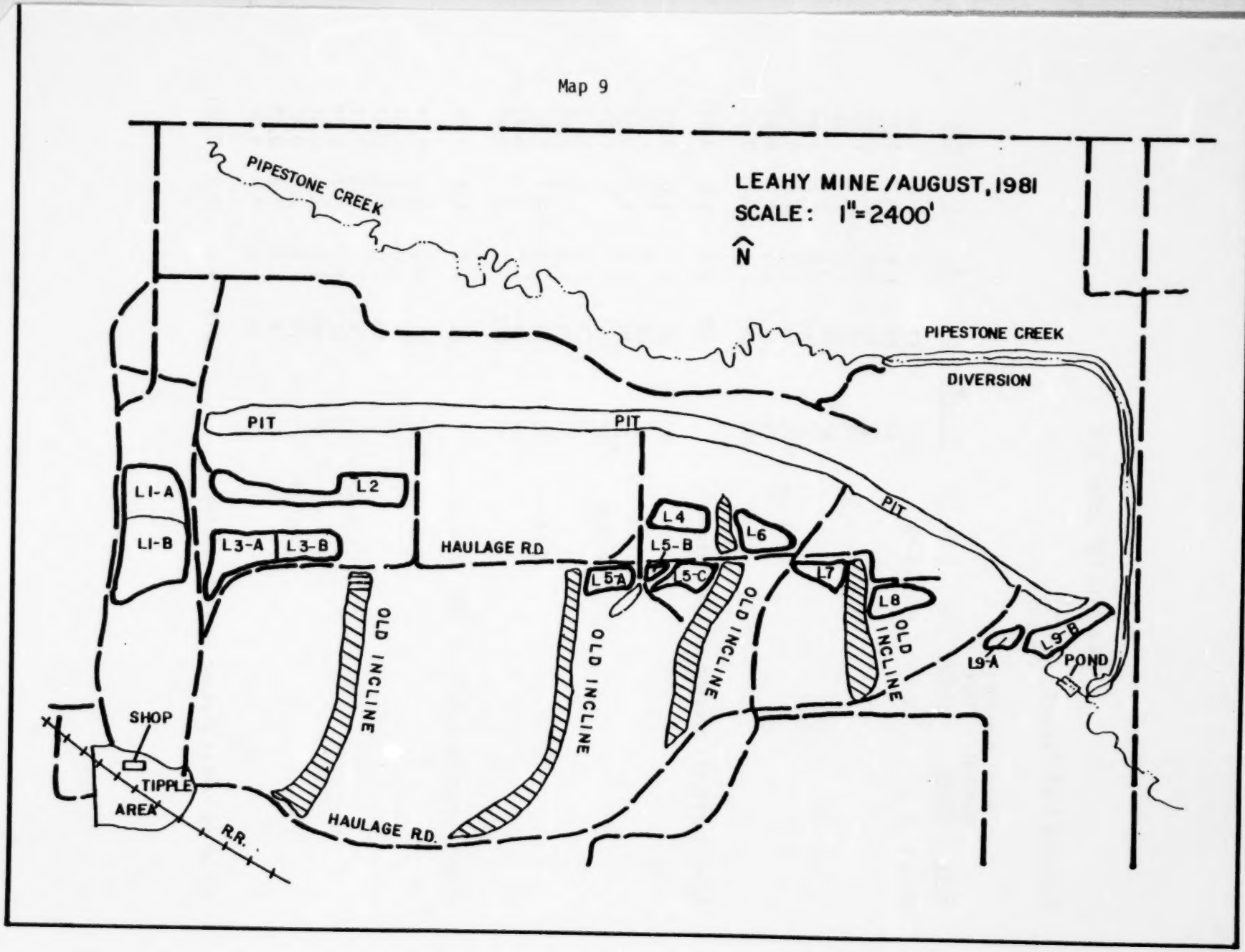
FIDELITY #11 MINE
KATHLEEN PIT

Area	Slope Averages Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
F11-D	3.7	182'	.46	C-SB	SPC	.51	1.0	19.1	3.8T
					CP	.25	1.0	9.4	1.9T
					NT	.10	1.0	3.7	0.7T
				C-SB-Gx	SPC	.26	1.0	9.7	1.9T
					CP	.18	1.0	6.7	1.3T
					NT	.097	1.0	3.6	0.7T
				C-SB-G-M	SPC	.14	1.0	5.2	1.0T
					CP	.14	1.0	5.2	1.0T
					NT	.067	1.0	2.5	0.5T
Cover currently present or 1981 seeding						.13	1.0	4.9	1.0T
F11-E	3.0	471'	.46	C-SB	SPC	.51	1.0	19.1	3.8T
					CP	.25	1.0	9.4	1.9T
					NT	.10	1.0	3.7	0.7T
				C-SB-Gx	SPC	.26	1.0	9.7	1.9T
					CP	.18	1.0	6.7	1.3T
					NT	.097	1.0	3.6	0.7T
				C-SB-G-M	SPC	.14	1.0	5.2	1.0T
					CP	.14	1.0	5.2	1.0T
					NT	.067	1.0	2.5	0.5T
Cover currently present or 1981 seeding						.021	1.0	0.8	0.16T
F11-F	0.8	775'	.23	C-SB	SPC	.51	1.0	9.5	1.9T
					CP	.25	1.0	4.7	0.9T
					NT	.10	1.0	1.9	0.4T
				C-SB-Gx	SPC	.26	1.0	4.9	1.0T
					CP	.18	1.0	3.4	0.7T
					NT	.097	1.0	1.8	0.4T
				C-SB-G-M	SPC	.14	1.0	2.6	0.5T
					CP	.14	1.0	2.6	0.5T
					NT	.067	1.0	1.3	0.3T
Cover currently present or 1981 seeding						.042	1.0	0.8	0.16T
F11-G	1.1	415'	.22	C-SB	SPC	.51	1.0	9.1	1.8T
					CP	.25	1.0	4.5	0.9T
					NT	.10	1.0	1.8	0.4T
				C-SB-Gx	SPC	.26	1.0	4.7	0.9T
					CP	.18	1.0	3.2	0.6T

Area	Slope Averages Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
					NT	.097	1.0	1.7	0.3T
				C-SB-G-M	SPC	.14	1.0	2.5	0.5T
					CP	.14	1.0	2.5	0.5T
					NT	.067	1.0	1.2	0.2T
Cover currently present or 1981 seeding						.042	1.0	0.8	0.16T
F11-H	3.3	271'	.43	C-SB	SPC	.51	1.0	17.9	3.6T
					CP	.25	1.0	8.6	1.8T
					NT	.10	1.0	3.5	0.7T
				C-SB-Gx	SPC	.26	1.0	9.1	1.8T
					CP	.18	1.0	6.3	1.3T
					NT	.097	1.0	3.4	0.7T
				C-SB-G-M	SPC	.14	1.0	4.9	1.0T
					CP	.14	1.0	4.9	1.0T
					NT	.067	1.0	2.3	0.5T
Cover currently present or 1981 seeding						.36	1.0	12.6	2.5T

Source: Data compiled by Greater Egypt Regional Planning and Development Commission staff

Map 9


LEAHY MINE / AUGUST, 1981
SCALE: 1"=2400'
N
PIPESTONE CREEK
PIPESTONE CREEK
DIVERSION
PIT
PIT
PIT
L1-A
L1-B
L2
L3-A
L3-B
HAULAGE RD.
L4
L5-B
L6
L5-A
L5-C
L7
L8
L9-B
L9-A
POND
OLD INCLINE
OLD INCLINE
OLD INCLINE
OLD INCLINE
SHOP
TIPPLE
AREA
R.R.
HAULAGE R.D.

USLE DATA FOR LEAHY MINE

Constant USLE Factors R = 220
K = .37

Area	Slope Averages Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
L1-A	1.9	652'	.35	C-SB	SPC	.51	1.0	14.5	2.9T
					CP	.25	1.0	7.1	1.4T
					NT	.10	1.0	2.8	0.6T
				C-SB-Gx	SPC	.26	1.0	7.4	1.5T
					CP	.18	1.0	5.1	1.0T
					NT	.097	1.0	2.8	0.6T
				C-SB-G-M	SPC	.14	1.0	4.0	0.8T
					CP	.14	1.0	4.0	0.8T
					NT	.067	1.0	1.9	0.4T
Cover currently present or 1981 seeding						.006	1.0	0.2	0.04T
L1-B				C-S	SPC	.51	1.0	14.9	3.0T
					CP	.25	1.0	7.3	1.5T
					NT	.10	1.0	2.9	0.6T
				C-SB-Gx	SPC	.26	1.0	7.6	1.5T
					CP	.18	1.0	5.3	1.1T
					NT	.097	1.0	2.8	0.6T
				C-SB-G-M	SPC	.14	1.0	4.1	0.8T
					CP	.14	1.0	4.1	0.8T
					NT	.067	1.0	2.0	0.4T
Cover currently present or 1981 seeding						.22	1.0	6.4	1.3T
L2				C-S	SPC	.51	1.0	10.4	2.1T
					CP	.25	1.0	5.1	1.0T
					NT	.10	1.0	2.0	0.4T
				C-SB-Gx	SPC	.26	1.0	5.3	1.1T
					CP	.18	1.0	3.7	0.7T
					NT	.097	1.0	2.0	0.4T
				C-SB-G-M	SPC	.14	1.0	2.8	0.6T
					CP	.14	1.0	2.8	0.6T
					NT	.067	1.0	1.4	0.3T
Cover currently present or 1981 seeding						.013	1.0	0.3	0.06T

Area	Slope Averages Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
L3-A	1.5	400'	.26	C-SB	SPC	.51	1.0	10.8	2.2T
					CP	.25	1.0	5.3	1.1T
					NT	.10	1.0	2.1	0.4T
				C-SB-Gx	SPC	.26	1.0	5.5	1.1T
					CP	.18	1.0	3.8	0.8T
					NT	.097	1.0	2.1	0.4T
				C-SB-G-M	SPC	.14	1.0	3.0	0.6T
					CP	.14	1.0	3.0	0.6T
					NT	.067	1.0	1.4	0.3T
Cover currently present or 1981 seeding						.059	1.0	1.2	0.2T
L3-B	1.5	650'	.29	C-S	SPC	.51	1.0	12.0	2.4T
					CP	.25	1.0	5.9	1.2T
					NT	.10	1.0	2.4	0.5T
				C-SB-Gx	SPC	.26	1.0	6.1	1.2T
					CP	.18	1.0	4.2	0.8T
					NT	.097	1.0	2.3	0.5T
				C-SB-G-M	SPC	.14	1.0	3.3	0.7T
					CP	.14	1.0	3.3	0.7T
					NT	.067	1.0	1.6	0.3T
Cover currently present or 1981 seeding						.013	1.0	0.3	0.06T
L4	1.0	750'	.24	C-S	SPC	.51	1.0	10.0	2.0T
					CP	.25	1.0	4.9	1.0T
					NT	.10	1.0	2.0	0.4T
				C-SB-Gx	SPC	.26	1.0	5.1	1.0T
					CP	.18	1.0	3.5	0.7T
					NT	.097	1.0	1.9	0.4T
				C-SB-G-M	SPC	.14	1.0	2.7	0.5T
					CP	.14	1.0	2.7	0.5T
					NT	.067	1.0	1.3	0.3T
Cover currently present or 1981 seeding						.013	1.0	0.3	0.06T
L5-A	1.5	825'	.30	C-SB	SPC	.51	1.0	12.5	2.5T
					CP	.25	1.0	6.1	1.2T
					NT	.10	1.0	2.4	0.5T
				C-SB-Gx	SPC	.26	1.0	6.3	1.3T
					CP	.18	1.0	4.4	0.9T
					NT	.097	1.0	2.4	0.5T
				C-SB-G-M	SPC	.14	1.0	3.4	0.7T
					CP	.14	1.0	3.4	0.7T
					NT	.067	1.0	1.6	0.3T
Cover currently present or 1981 seeding						.013	1.0	0.3	0.06T

Area	Slope Averages Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
L5-B	0.5	650'	.18	C-SB	SPC	.51	1.0	7.5	1.5T
					CP	.25	1.0	3.7	0.7T
					NT	.10	1.0	1.5	0.3T
				C-SB-Gx	SPC	.26	1.0	3.8	0.8T
					CP	.18	1.0	2.6	0.5T
					NT	.097	1.0	1.4	0.3T
				C-SB-G-M	SPC	.14	1.0	2.1	0.4T
					CP	.14	1.0	2.1	0.4T
					NT	.067	1.0	1.0	0.2T
Cover currently present or 1981 seeding						.003	1.0	0.04	0.01T
L5-C	1.5	600'	.28	C-S	SPC	.51	1.0	11.6	2.3T
					CP	.25	1.0	5.7	1.1T
					NT	.10	1.0	2.3	0.5T
				C-SB-Gx	SPC	.26	1.0	5.9	1.2T
					CP	.18	1.0	4.1	0.8T
					NT	.097	1.0	2.2	0.4T
				C-SB-G-M	SPC	.14	1.0	3.2	0.6T
					CP	.14	1.0	3.2	0.6T
					NT	.067	1.0	1.5	0.3T
Cover currently present or 1981 seeding						.013	1.0	0.3	0.06T
L6	1.6	690'	.29	C-SB	SPC	.51	1.0	12.0	2.4T
					CP	.25	1.0	5.9	1.2T
					NT	.10	1.0	2.4	0.5T
				C-SB-Gx	SPC	.26	1.0	6.1	1.2T
					CP	.18	1.0	4.2	0.8T
					NT	.097	1.0	2.3	0.5T
				C-SB-G-M	SPC	.14	1.0	3.3	0.7T
					CP	.14	1.0	3.3	0.7T
					NT	.067	1.0	1.6	0.3T
Cover currently present or 1981 seeding						.013	1.0	0.3	0.06T
L7	2.0	175'	.24	C-SB	SPC	.51	1.0	10.0	2.0T
					CP	.25	1.0	4.9	1.0T
					NT	.10	1.0	2.0	0.4T
				C-SB-Gx	SPC	.26	1.0	5.1	1.0T
					CP	.18	1.0	3.5	0.7T
					NT	.097	1.0	1.9	0.4T
				C-SB-G-M	SPC	.14	1.0	2.7	0.5T
					CP	.14	1.0	2.7	0.5T
					NT	.067	1.0	1.3	0.3T
Cover currently present or 1981 seeding						.008	1.0	0.2	0.04T

Area	Slope Averages: Percent Slope	Slope Length	LS	Rotation	Tillage	C	P	E	E/T
L8	2.3	400'	.35	C-SB	SPC	.51	1.0	14.5	2.9T
					CP	.25	1.0	7.1	1.4T
					NT	.10	1.0	2.8	0.6T
				C-SB-Gx	SPC	.26	1.0	7.4	1.5T
					CP	.18	1.0	5.1	1.0T
					NT	.097	1.0	2.8	0.6T
				C-SB-G-M	SPC	.14	1.0	4.0	0.8T
					CP	.14	1.0	4.0	0.8T
					NT	.067	1.0	1.9	0.4T
Cover currently present or 1981 seeding						.013	1.0	0.4	0.08T
L9-A	4.0	195'	.53	C-SB	SPC	.51	1.0	22.0	4.4T
					CP	.25	1.0	10.8	2.2T
					NT	.10	1.0	4.3	0.9T
				C-SB-Gx	SPC	.26	1.0	11.2	2.2T
					CP	.18	1.0	7.8	1.6T
					NT	.097	1.0	4.2	0.8T
				C-SB-G-M	SPC	.14	1.0	6.0	1.2T
					CP	.14	1.0	6.0	1.2T
					NT	.067	1.0	2.9	0.6T
Cover currently present or 1981 seeding						.013	1.0	0.6	0.1T
L9-B	2.9	388'	.43	C-SB	SPC	.51	1.0	17.9	3.6T
					CP	.25	1.0	8.6	1.8T
					NT	.10	1.0	3.5	0.7T
				C-SB-Gx	SPC	.26	1.0	9.1	1.8T
					CP	.18	1.0	6.3	1.3T
					NT	.097	1.0	3.4	0.7T
				C-SB-G-M	SPC	.14	1.0	4.9	1.0T
					CP	.14	1.0	4.9	1.0T
					NT	.067	1.0	2.3	0.5T
Cover currently present or 1981 seeding						.003	1.0	0.1	0.02T

Source: Data compiled by Greater Egypt Regional Planning and Development Commission staff

Premining soils, slope and land cover information were gathered for most of the Rule 1104 reclaimed areas. When these data were used to derive USLE factors, soil loss estimates could be made for these areas as they were before mining began. Soil losses were then calculated using the C factors for four of the same hypothetical cropping and tillage regimes used in the soil loss estimates calculations for the Rule 1104 reclaimed areas in their post mining condition. These results were expected to give an indication of what the soil loss characteristics of the affected areas would have been had they not been disturbed by surface mining.

Premining Soil Loss Estimate Averages

Mine	K	LS	Rotation	Tillage	C	P	E*	T	E/T**
Burning Star #2	.43	.44	C-SB	SPC	.51	1.0	21.1	3.1	6.7T
				CP	.25	1.0	10.4		2.1T
Pinckneyville				NT	.10	1.0	4.2		1.3T
Pit#3			C-SB-G-M	SPC	.14	1.0	5.8		1.9T
				CP	.14	1.0	5.8		1.9T
				NT	.067	1.0	2.8		0.9T
Premining Land Use					.22	1.0	9.2		3.0T
Burning Star #4	.41	.37	C-SB	SPC	.51	1.0	17.0	3.6	4.7T
				CP	.25	1.0	8.3		1.7T
South Pit				NT	.10	1.0	3.3		0.9T
			C-SB-G-M	SPC	.14	1.0	4.7		1.3T
				CP	.14	1.0	4.7		1.3T
				NT	.067	1.0	2.2		0.6T
Premining Land Use					.17	1.0	5.7		1.6T
Captain Mine	.41	.54	C-SB	SPC	.51	1.0	24.8	3.1	8.0T
				CP	.25	1.0	12.2		2.4T
6360 Pit				NT	.10	1.0	4.9		1.6T
			C-SB-G-M	SPC	.14	1.0	6.8		2.2T
				CP	.14	1.0	6.8		2.2T
				NT	.067	1.0	3.3		1.1T
Premining Land Use					.167	1.0	8.1		2.6T
Captain Mine	.39	.67	C-SB	SPC	.51	1.0	29.3	3.3	8.9T
				CP	.25	1.0	14.4		2.9T
2570 Pit				NT	.10	1.0	5.7		1.7T
			C-SB-G-M	SPC	.14	1.0	8.0		2.4T
				CP	.14	1.0	8.0		2.4T
				NT	.067	1.0	3.9		1.2T
Premining Land Use					.018	1.0	1.0		0.3T

Mine	K	LS	Rotation	Tillage	C	P	E*	T	E/T**
Fidelity #11	.41	.46	C-SB	SPC	.51	1.0	21.2	3.4	6.2T
				CP	.25	1.0	10.4		2.1T
Northwest Pit				NT	.10	1.0	4.5		1.3T
			C-SB-G-M	SPC	.14	1.0	5.8		1.7T
				CP	.14	1.0	5.8		1.7T
				NT	.067	1.0	2.8		0.8T
Premining Land Use					.17	1.0	7.1		2.1T
Fidelity #11	.43	.27	C-SB	SPC	.51	1.0	13.0	2.9	4.5T
				CP	.25	1.0	6.4		1.3T
Kathleen Pit				NT	.10	1.0	2.3		0.8T
			C-SB-G-M	SPC	.14	1.0	3.6		1.2T
				CP	.14	1.0	3.6		1.2T
				NT	.067	1.0	1.7		0.6T
Premining Land Use					.23	1.0	5.9		2.0T
Leahy Mine	.43	.72	C-SB	SPC	.51	1.0	34.7	3.1	11.2T
				CP	.25	1.0	17.0		3.4T
				NT	.10	1.0	6.8		2.2T
			C-SB-G-M	SPC	.14	1.0	9.5		3.1T
				CP	.14	1.0	9.5		3.1T
				NT	.067	1.0	4.6		1.5T
Premining Land Use					.051	1.0	3.6		1.2T

* - Tons per acre per year estimated soil loss
**- Estimated soil loss divided by the composite tolerance factor for the compliments of soil series found within the reclaimed area as it was before mining

DISCUSSION AND CONCLUSIONS

Discussion

Sediment and erosion control standards set by the Perry County Soil and Water Conservation District Board with the help of the County Advisory Committee were presented for review and comment in August, 1981. These standards set the following soil loss goals:

> Effective January 1, 1983 to January 1, 1985, all land subject to this program shall not be considered out of compliance with the county program, if the long term annual soil losses are kept at or below four "T" value.

> Effective January 1, 1985, no soil erosion losses on gently sloping land, not exceeding 5 percent slope, shall exceed "T" value provided this can be accomplished through conservation tillage. All other land subject to this program shall be considered in compliance with the county program, if the long term annual soil losses are kept at or below double "T" during the period January 1, 1985, to January 1, 1990.

> Effective January 1, 1990, to January 1, 1995, all land subject to this program shall be considered in compliance with the county program if the long term annual soil losses are kept at or below one and one-half "T" value.

> Effective January 1, 1995, and thereafter, all land subject to the Act shall meet "T" value.

When hypothetical rotations and tillage methods were applied with the USLE to the 42 reclaimed areas, some of the rotation and tillage combinations yielded soil loss estimates beyond tolerance levels. By 1995, standards for Perry County areas would have row crop limitations as indicated below. Various

crop rotations could be tried by inserting other C values into the USLE while R, K, LS and P factors remain as they are here. The effect of single crops can also be checked in this way. Various conservation practices can be checked by substituting the appropriate P factor and keeping all other factors the same. Within the limits of the nine rotation and tillage combinations used in this report, the capability of 1104 reclaimed areas in Perry County for row crops at below tolerance level average soil loss over 2, 3 and 4 year rotations including one year corn and one year soybeans provided the following:

Maximum Row Crop Rotations Meeting 1XT

	Most Erosion-Prone * Rotation to Meet 1XT For Each Tillage Method			Does current Cover	Slope Characteristics	
Area	SPC	CP	NT	Meet T?	Percent	Length
B2-A	C-Sb-G-M	C-Sb-Gx	Sb	Yes	3.8	370'
B2-B	C-Sb-G-M	C-Sb-Gx	Sb	Yes	2.0	540'
B2-C	C-Sb-G-M	C-Sb-G-M	Sb	Yes	2.9	524'
B2-D	C-Sb-Gx	All	Sb	Yes	1.3	500'
B2-E	C-Sb-G-M	All	Sb	No	1.7	338'
B2-F	C-Sb-G-M	C-Sb-G-M	Sb	Yes	3.3	283'
B2-G	C-Sb-Gx	All	Sb	Yes	2.2	278'
B2-2	C-Sb-Gx	All	Sb	Yes	4.0	127'
B2-3A	C-Sb-G-M	C-Sb-Gx	Sb	Yes	4.8	130'
B2-3B	C-Sb-G-M	C-Sb-Gx	C-Sb-G-M	Yes	5.3	150'
B4-A	None	C-Sb-G-M	C-Sb-G-M	Yes	5.8	122'
B4-B	None	None	Sb	Yes	4.0	200'
B4-C	C-Sb-G-M	C-Sb-GxSB	Sb	Yes	2.9	163'
B4-D	C-Sb-G-M	C-Sb-Gx	Sb	Yes	2.4	165'
B4-E	C-Sb-Gx	All	Sb	Yes	3.5	132'
63-A	C-Sb-G-M	All	C-Sb-G-M	Yes	3.3	365'
63-B	C-Sb-G-M	C-Sb-Gx	Sb	Yes	1.9	437'
63-C	C-Sb-G-M	C-Sb-G-M	Sb	Yes	3.1	260'
63-D	C-Sb-G-M	C-Sb-Gx	Sb	Yes	2.9	220'
25-A	C-Sb-G-M	C-Sb-G-M	Sb	Yes	2.1	288'
25-B	C-Sb-G-M	C-Sb-G-M	Sb	Yes	2.6	433'
25-C	C-Sb-G-M	C-Sb-Gx	Sb	Yes	2.1	361'
F11-A	C-Sb-G-M	C-Sb-Gx	Sb	Yes	2.8	148'
F11-B	None	None	Sb	Yes	3.8	168'
F11-C	C-Sb-G-M	C-Sb-G-M	Sb	Yes	3.2	150'
F11-D	C-Sb-G-M	C-Sb-G-M	Sb	Yes	3.7	182'
F11-E	C-Sb-G-M	C-Sb-G-M	Sb	Yes	3.0	471'
F11-F	C-Sb-Gx	All	Sb	Yes	0.8	775'

Area	Most Erosion-Prone * Rotation to Meet 1XT For Each Tillage Method SPC	CP	NT	Does current Cover Meet T?	Slope Characteristics Percent	Length
F11-G	C-Sb-Gx	All	Sb	Yes	1.1	415'
F11-H	C-Sb-G-M	C-Sb-G-M	Sb	No	3.3	271'
L1-A	C-Sb-G-M	C-Sb-Gx	Sb	Yes	1.9	652'
L1-B	C-Sb-G-M	C-Sb-G-M	Sb	No	2.1	727'
L-2	C-Sb-G-M	All	Sb	Yes	1.0	950'
L3-A	C-Sb-G-M	C-Sb-Gx	Sb	Yes	1.5	400'
L3-B	C-Sb-G-M	C-Sb-Gx	Sb	Yes	1.5	650'
L-4	C-Sb-Gx	All	Sb	Yes	1.0	750'
L5-A	C-Sb-G-M	C-Sb-Gx	Sb	Yes	1.5	825'
L5-B	C-Sb-Gx	All	Sb	Yes	0.5	650'
L5-C	C-Sb-G-M	C-Sb-Gx	Sb	Yes	1.5	600'
L-6	C-Sb-G-M	C-Sb-Gx	Sb	Yes	1.6	690'
L-7	C-Sb-Gx	All	Sb	Yes	2.0	175'
L-8	C-Sb-G-M	C-Sb-Gx	Sb	Yes	2.3	400'
L9-A	None	None	Sb	Yes	4.0	195'
L9-B	C-Sb-G-M	C-Sb-G-M	Sb	Yes	2.9	388'

*In the sense that a greater percentage of row crop years in the rotation results in increased erosion potential while a greater percentage of grain and meadow years in the rotation results in decreased erosion potential.

Summary

Number and Percent of Areas Capable of Meeting 1XT

	Tillage	SPC	CP	NT
Rotation	C-Sb	0	12 (27%)	41 (93%)
	C-Sb-Gx	9 (20%)	17 (39%)	0
	C-Sb-G-M	31 (71%)	12 (27%)	3 (7%)
	None	4 (9%)	3 (7%)	0

Conclusions

An Ad Hoc Committee on Reclaimed Agricultural Lands was convened with membership representing the coal industry, agricultural interests, soil conservation concerns and research interests (Appendix C). This committee met to review the data gathered during the project, suggest management needs and discuss funding concepts. The committee members and Directors of Reclamation at the four Perry County mining companies were responsible for reviews and comment on this report. Committee discussions and review comments gave support to the following conclusions, based upon soil loss estimates given for each of the Rule 1104 areas after reclamation:

1. In general, crop rotations with grains and meadow in two seasons of each four year crop rotation, or use of no till farming practices will be necessary to maintain soil loss at below tolerance levels on reclaimed lands.

2. While many reclaimed areas may reach tolerance levels of soil loss somewhat easier than the same areas had they not been mined, others may require continuous grain or meadow or continuous no till farming to reach T levels of soil loss.

3. Long slope length appears to be the single most common factor causing excess erosion on reclaimed lands and limiting row crops in the rotation. (Twenty-one of the forty-two areas studied with slopes of less than 3% will require 50% grain or meadow to reach T with conventional tillage.) Plowing on the contour, conservation tillage, properly constructed terraces or contour strip cropping may allow a higher use of row cropping in the rotation on these lands.

4. All of the areas measured in this study appear capable of compliance with county sediment and erosion control standards by adapting croping sequences and tillage methods that are currently practiced elsewhere.

FOOTNOTES

[1]Illinois Department of Agriculture, Division of Natural Resources, State Erosion and Sediment Control Guidelines, April 18, 1980.

[2]Perry County Soil and Water Conservation District, Perry County Program and Standards, Pinckneyville, Illinois, 1981.

[3]Illinois Coal Association, Illinois Coal Facts - 1982, Springfield, Illinois, pp 11 and 51.

[4]Perry County Soil and Water Conservation District, Perry County Program and Standards, Pinckneyville, Illinois, 1981.

[5]Illinois Department of Mines and Minerals, Surface-Mined Land Conservation and Reclamation Act, Rules and Regulations, March 18, 1976.

[6]Illinois Coal Association, Illinois Coal Facts - 1982, Springfield, Illinois, p. 35.

[7]Ibid, p. 52.

[8]Ibid, pp 52-53.

[9]Allen F. Grandt, "Reclaimed Mined Land in Illinois for Row Crop Production," Journal of Soil and Water Conservation, September-October 1978, Vol. 33, No. 5, pp 242-244.

[10]R. Michael Miller and Roy E. Cameron, Some Effects on Soil Microbiota of Topsoil Storage During Surface Mining, Land Reclamation Program, Argonne National Laboratory, Argonne, Illinois.

[11] The Othent Soils have been placed in the Lensburg or Morristown series by the Perry County Soil Survey Team, Soil Conservation Service, USDA.

[12]Preliminary Review Draft describing the Shuline Series as prepared by the Perry County Soil Survey Team, Soil Conservation Service, USDA.

[13]Preliminary Review Draft describing the Swanwick Series as prepared by the Perry County Soil Survey Team, Soil Conservation Service, USDA.

Appendix A

EXCERPTS FROM STATE OF ILLINOIS RULES AND REGULATIONS FOR MINE RECLAMATION

Rule 1103 -- Land Not Requiring Reclamation

In cases where pools or lakes capable of supporting aquatic life may be formed by rainfall or drainage runoff from adjoining land, the depressed haulage roads or final cuts or any other area to be occupied by pools or lakes, if approved by the Department, (Illinois Department of Mines and Minerals) shall not require any further reclamation. Where the Director determines that a road, dry pit bottom or ditch is consistent with and necessary to the conservation and reclamation plan for an area, no further reclamation shall be required.

Rule 1104 -- Land To Be Reclaimed For Row Crop Agriculture

When the Director determines that the land to be affected is (1) capable of being reclaimed for row-crop agricultural purposes and suitable for row-crop agricultural purposes based on United States Soil Conservation Service soil survey classifications of the affected land prior to mining, and (2) when the Director determines that the optimum future use of the land affected is for row-crop agricultural purposes, the affected land shall be graded to the approximate original grade of the land and all or part of the darkened surface soil, as defined in this Act, shall be segregated during the stripping process and replaced as a final cover as a last step in the required grading. When available in such depth, at least 18 inches of the darkened surface soil exists all such lesser amounts shall be segregated and replaced. In no case shall less than the top 8 inches of surface soil, darkened or not, be segregated and replaced. This segregation and replacement requirement may be altered by the Department only if it is determined upon the advice of competent soil scientists that other material available in the cast overburden would be suitable in meeting the reclamation requirements. Below the darkened surface soil the replaced material shall be suitable as an agricultural root medium. The Department shall determine by rules and regulations what constitutes a suitable agricultural root medium by composition and depth. On all lands to be reclaimed the operator shall not be required to create a soil condition better than that which existed prior to surface mining.

Slope classifications of lands before mining are (a) 0 to 2%; (b) 2 to 5%; (c) 5 to 10%.

Approximate original grade means the grading of affected lands which were originally of the (a) and (b) slope classifications to a maximum slope not to exceed 5% slope with a planned erosion control system approved by the Director for 3 to 5% slopes.

Approximate original grade means the grading of affected lands which were originally of the (c) 5 to 10% slope to a maximum slope not to exceed 10% and shall have a planned erosion control system approved by the Director.

Planned terrace systems, when utilized as part of a planned erosion control system, shall be constructed according to U.S. Department of Agriculture Soil Conservation Service specifications.

Slopes on all affected lands shall be measured from the drainage divide to the base of the slope or to the intermittent water course as the lowest point. Abrupt slope changes between these points are not acceptable except for unusual conditions such as ditches, terraces, and roads.

The length of slope and contour of the restored surface shall be conducive to those farming operations normally associated with row crop production. Farming operations as used here shall include such measures or practices necessary to provide adequate drainage and erosion control for sustained new row crop production.

The materials under the darkened surface soil suitable as a root medium shall contain no more than 20% coarse material greater than 2mm in size by volume. No more than half of the course material may be between 3 inches and 10 inches in the greatest dimension. In no case may clay material of less than 2 microns be greater than 40% by weight.

These texture requirements do not apply if the soil conditions of the affected land prior to mining did not meet the standards included herein (i.e., if more than 20% coarse material by volume existed in the root medium below the darkened

surface soil prior to mining, the same percentage of course material in the root medium will be allowed after mining; if more than one-half of the coarse material consisted of rocks in the 3 to 10 inch size category prior to mining, that same percentage will be permitted after mining; and if more than 40% by weight of clay materials less than 2 microns in size existed in the root medium below the darkened surface soil prior to mining, a like percentage by weight will be allowed after mining in the material under the darkened surface soil.)

In addition to meeting texture requirements, the materials under the darkened surface soil, must be chemically suitable as an agricultural root medium. Materials suitable as an agricultural root medium shall be of a vertical thickness adequate, including the darkened surface soil, to ensure a total depth of four feet. Pyritic material capable of producing toxic acidic conditions shall not be incorporated within the surface four foot layer of finally graded lands.

The Director may alter the slope and texture requirements under this Rule only upon a clear and convincing showing that to vary such requirements would better effectuate the purposes of this Act than would enforcing the standards herein.

Location of texture compliance samples will be determined by random methods similar to those described in Rule 1202 (b) (1) of the Rules and Regulations and texture analysis shall be determined by methods as subscribed by the Department.

The final cut and submerged roadways may remain if the Department determines that such final cut or roadway could form a water impoundment capable of supporting desirable uses such as water for livestock or wildlife; and if to be used for fish life, shall have minimum depths in accordance with standards for fish stocking as recommended by the Department. All impoundments and structures must be included in the reclamation plan for approval or disapproval by the Department. The boxcut spoil shall be graded in accordance with Section 6 of the Act, and with these Rules and Regulations.

Summary of Illinois Surface Mining Laws and Their Requirements

Open Cut Land Reclamation Act January 1, 1962
PERMIT: Reclamation plan submitted and approved after land was affected.

Permit issued for permit year, July 1 to June 30 of following year. Surety bond posted prior to permit issuance. Minimum bond $1,000 for 5 acres or less; bond of $200 per acre in excess of 5 acres.
GRADING: Pasture reclamation and land adjacent to public highway. Strike off of spoil ridge top to minimum width of 10 feet.
VEGETATION: Seeding and planting to be carried out in a workmanlike manner. Reclamation to be completed within 3 years after reclamation plan approval.

Surface Mined Land Reclamation Act (July 1, 1968)
PERMIT: Regulation of refuse (slurry and gob) disposal began. Surety bond required.
GRADING: Minimum width of strike off increased to 18 feet for pasture reclamation; land within 660 feet of a public road and visible, slope of 30% or less required.
VEGETATION: Minimum stand and stocking standards required.
PASTURE: 65% stand first growing season, 85% stand second season.
FORESTATION: 500 trees per acre first growing season; 450 trees per acre second season.

Surface-Mined Land Conservation and Reclamation Act (September 17, 1971)
PPERMIT: Permit required for refuse disposal. Reclamation plan for both surface mining and refuse permits submitted to county board; board has 25 days in which to make recommendations on proposed reclamation plan. Surface mining bond $600 to $1,000 per acre.
GRADING: To be completed within one year after termination of permit year in which land was affected; vegetation to be completed within three years.
GRADING - General: All land graded to a slope of 15% or less except re-forestation outside slopes, final cut slopes, and side slopes of incline haulage roads which had a slope requirement of 30% or less.
GRADING - Coal Operators: Row crop agricultural reclamation returned to approximate original grade (within 4%). Top four feet returned-texture specified.

Surface-Mined Land Conservation and Reclamation Act - Amended 1975 (July 1, 1975)
PERMIT: Surface mining permits issued for a permit period up to 3 years. Surface mining bond $600 to $5,000 per acre. Entire application submitted to county board; board has 45 days to submit recommendations and/or request that a public hearing be held by Department on proposed reclamation plan.
GRADING - Coal Operators: Highwall graded to a slope of 50% or less. Row crop agricultural reclamation - darkened surface soil to be segregated and replaced - where available, at least 18", or no less than 8". Material below replaced surface soil must be a suitable agricultural root medium of a specified texture.

Surface-Mined Land Conservation and Reclamation Act - Amended 1977 (October 1, 1977)

GRADING: Final cut spoil and side slopes of haulage road inclines can remain at a slope equal to angle of repose of the material.

State Reclamation Laws

Dates:	Grading & Soil Replacement Requirements
1962 Open Cut Land Reclamation Act	10 feet wide strike off of spoilridge top - pasture reclamation
1968 SMLR Act	Strike off 18 feet wide, pasture and forestation stand requirement; 85% stand second season; 450 trees/acre second season.
1971 SMLC&R Act	Grade all to slope of 15% or less except out slopes, final cut slopes and incline slopes 30% or less. Row crop lands to approximate original grade, 4% or less and return top 4 feet texture specified. Plan to county boards for recommendations in 25 days.
1975 (Amendments to 1971)	Row crop agriculture reclamation at least 8" surface soil segregated and replaced - suitable root medium below. Permit application to counties for recommendation and possible public hearing in 45 days.
1977 (Amendments to 1971)	Final cut spoil and side slopes of haulage incline can remain at angle of repose.

Appendix B

UNIVERSAL SOIL LOSS EQUATION

The Universal Soil Loss Equation is a primary tool in estimating erosion of specific land areas. The equation takes into account the major factors determining the soil loss that will occur as a result of erosion. The basis equation can be expressed as:

$$E = R\ K\ L\ S\ C\ P$$

where:

E is the computed soil loss per year per unit area of land expressed in tons per acre.

R is the average annual rainfall erosion index or the average annual force of rainfall.

K is the soil erodibility factor. It is a measure of the rate at which a soil will erode expressed as tons per acre per year per unit of R for a 9 percent slope 72.6 feet long under continuous cultivated farrow. (Soil loss tolerance (T) is not found in the equation, but is important to the use of the equation in practical field application. It is the maximum soil loss in tons per acre per year which can be tolerated on a specific soil and still permit a high level of crop production to be sustained economically and indefinitely.)

L is the slope length factor. It is the ratio of soil loss from a specified slope length to that from a slope length of 72.6 feet long, which is the slope length for the K value in the equation. A slope length of 72.6 feet long has a factor value of 1.L as determined in the field.

S is the slope gradient factor. It is the ratio of soil loss from a specific slope gradient to that from a gradient of 9 percent, which is the slope gradient specified for the K value in the soil loss equation. A slope gradient of 9 percent has a factor value of 1.S as determined in the field. L and S are usually handled in combination. The soil loss ratio LS, can be read directly from the slope-effect chart.

C is the cropping management factor. It is the ratio of soil loss from land cropped under specified conditions to the corresponding loss from the land in continuous fallow. Continuous fallow has a factor value of 1 in the equation.

P is the conservation practice factor. It is the ratio of soil loss from a specified conservation practice to that from up-and-down hill tillage operations. Up-and-down hill tillage has a factor value of 1 in the equation.

Source: Greater Egypt Regional Planning and Development Commission, November, 1978, Areawide Waste Treatment and Water Quality Management Plan for Southern Illinois, Appendix B-2, Pollution Sources: Agriculture.

SOIL LOSS RATIO (LS)

(Rev. 3-75)

LENGTH OF SLOPE (L)	PERCENT SLOPE (S)																					
	0.2	0.3	0.4	0.5	1.0	2.0	3.0	4.0	5.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	25.0	30.0	40.0	50.0	60.0
20	.05	.05	.06	.06	.08	.12	.18	.21	.24	.30	.44	.61	.81	1.0	1.2	1.6	1.8	2.6	3.5	5.5	8	10
40	.06	.07	.07	.08	.10	.15	.22	.28	.34	.43	.63	.87	1.2	1.4	1.8	2.2	2.6	3.5	5.0	8	11	15
60	.07	.08	.08	.08	.11	.17	.25	.33	.41	.52	.77	1.0	1.4	1.8	2.2	2.6	3.0	4.5	6.0	10	14	18
80	.08	.08	.09	.09	.12	.19	.27	.37	.48	.60	.89	1.2	1.6	2.0	2.6	3.0	3.5	5.5	7	11	16	21
100	.08	.09	.09	.10	.13	.20	.29	.40	.54	.67	.99	1.4	1.8	2.2	2.8	3.5	4.0	6.0	8	13	18	23
110	.08	.09	.10	.10	.13	.21	.30	.42	.56	.71	1.0	1.4	1.8	2.4	3.0	3.5	4.5	6.0	8	13	19	24
120	.09	.09	.10	.10	.14	.21	.30	.43	.59	.74	1.0	1.6	2.0	2.6	3.0	4.0	4.5	6.0	9	14	20	25
130	.09	.09	.10	.11	.14	.22	.31	.44	.61	.77	1.2	1.6	2.0	2.6	3.0	4.0	4.5	7	9	14	20	26
140	.09	.10	.10	.11	.14	.22	.32	.46	.63	.80	1.2	1.6	2.2	2.8	3.5	4.0	5.0	7	9	15	21	27
150	.09	.10	.11	.11	.15	.23	.32	.47	.66	.82	1.2	1.6	2.2	2.8	3.5	4.0	5.0	7	10	15	22	28
160	.09	.10	.11	.11	.15	.23	.33	.48	.68	.85	1.2	1.8	2.2	3.0	3.5	4.5	5.0	7	10	16	23	29
180	.10	.10	.11	.12	.15	.24	.34	.51	.72	.90	1.4	1.8	2.4	3.0	4.0	4.5	5.5	8	11	17	24	31
200	.10	.11	.11	.12	.16	.25	.35	.53	.76	.95	1.4	2.0	2.6	3.0	4.0	5.0	6.0	8	11	18	25	33
300	.11	.12	.13	.14	.18	.28	.40	.62	.93	1.2	1.8	2.4	3.0	4.0	5.0	6.0	7	10	14	22	31	40
400	.12	.13	.14	.15	.20	.31	.44	.70	1.0	1.4	2.0	2.8	3.5	4.5	5.5	7	8	12	16	25	36	46
500	.13	.14	.15	.16	.21	.33	.47	.76	1.2	1.6	2.2	3.0	4.0	5.0	6.0	8	9	13	18	28	40	52
600	.14	.15	.16	.17	.22	.34	.49	.82	1.4	1.6	2.4	3.5	4.5	5.5	7	8	10	14	19	31	44	57
700	.15	.16	.17	.18	.23	.36	.52	.87	1.4	1.8	2.6	3.5	5.0	6.0	8	9	11	16	21	33	47	61
800	.15	.16	.17	.18	.24	.38	.54	.92	1.6	2.0	2.8	4.0	5.0	6.0	8	10	12	17	22	36	50	65
900	.16	.17	.18	.19	.25	.39	.56	.96	1.6	2.0	3.0	4.0	5.5	7	9	10	12	18	24	38	53	69
1000	.16	.18	.19	.20	.26	.40	.57	1.0	1.6	2.2	3.0	4.5	5.5	7	9	11	13	19	25	40	56	73
1100	.17	.18	.19	.20	.27	.41	.59	1.0	1.8	2.2	3.5	4.5	6.0	8	9	11	14	20	26	42	59	77
1200	.17	.18	.20	.21	.27	.42	.61	1.0	1.8	2.4	3.5	4.5	6.0	8	10	12	14	20	28	44	62	80
1300	.18	.19	.20	.21	.28	.43	.62	1.2	2.0	2.4	3.5	5.0	7	8	10	12	15	21	29	46	64	83
1400	.18	.19	.21	.22	.29	.44	.63	1.2	2.0	2.6	3.5	5.0	7	9	11	13	15	22	30	47	67	87
1500	.19	.20	.21	.22	.29	.45	.65	1.2	2.0	2.6	4.0	5.5	7	9	11	13	16	23	31	49	69	90
1600	.19	.20	.21	.23	.30	.46	.66	1.2	2.2	2.6	4.0	5.5	7	9	11	14	16	24	32	51	71	93
1700	.19	.21	.22	.23	.30	.47	.67	1.2	2.2	2.8	4.0	5.5	7	9	12	14	17	24	33	52	73	95
2000	.20	.22	.23	.24	.32	.49	.71	1.4	2.4	3.0	4.5	6.0	8	10	13	15	18	26	36	57	80	104

CONTOUR LIMITS - 2 PERCENT 400 FEET, 8 PERCENT 200 FEET, 10 PERCENT 100 FEET, 14 - 24 PERCENT 60 FEET. THE EFFECTIVENESS OF CONTOURING BEYOND THESE LIMITS IS SPECULATIVE.

WHEN THE LENGTH OF SLOPE EXCEEDS 400 FEET AND (OR) PERCENT OF SLOPE EXCEEDS 24 PERCENT, SOIL LOSS ESTIMATES ARE SPECULATIVE AS THESE VALUES ARE BEYOND THE RANGE OF RESEARCH DATA.

USDA - SCS - Illinois - Area 7
December 1977

Table B-3. Crop Management C Factor Values for Southern Illinois

Crop sequence	Conventional-tillage systems					Conservation-tillage systems									
						Systems such as chisel planting, till plant, or strip till[b]					Systems such as zero-till, no-till, or slot plant				
	Fall plow Conventional till		Spring plow Conventional till		Plow plant or wheel track plant	Corn residue or equivalent on the surface after planting					Corn residue or equivalent on the surface after planting				
	Crop yields = high[a]					1,000 to 2,000 lb.	2,000 to 3,000 lb.	3,000 to 4,000 lb.	4,000 to 6,000 lb.	6000+ lb.	1,000 to 2,000 lb.	2,000 to 3,000 lb.	3,000 to 4,000 lb.	4,000 to 6,000 lb.	6000+ lb.
	RdL	RdR	RdL	RdR	RdL										
Cont. Soybeans	0.61	-	0.51	-	0.42	0.33	0.26	-	-	-	0.27	0.14	-	-	-
C-Sb[c]	0.51	0.61	0.44	0.54	0.35	0.32	0.25	0.17	0.14	0.12	0.26	0.14	0.10	0.058	0.038
C-C-Sb	0.48	0.59	0.40	0.51	0.32	0.30	0.23	0.16	0.13	0.11	0.26	0.14	0.10	0.058	0.038
Cont. Corn.	0.42	0.59	0.36	0.53	0.27	0.29	0.21	0.12	0.069	0.046	0.26	0.14	0.10	0.053	0.030
C-C-Sb-G_x*	0.34	0.42	0.29	0.36	0.23	0.25	0.19	0.13	0.097	0.081	0.17	0.12	0.10	0.078	0.067
C-Sb-G_x*	0.31	0.37	0.26	0.31	0.21	0.23	0.18	0.14	0.11	0.093	0.13	0.11	0.097	0.086	0.079
C-C-Sb-G-M*	0.22	0.28	0.18	0.24	0.13	0.18	0.15	0.12	0.096	0.087	0.13	0.090	0.075	0.058	0.049
C-G-M	0.070	-	0.050	-	0.032	-	-	-	-	-	-	-	-	0.023	0.021
C-Sb-G-M*	0.17	0.21	0.14	0.17	0.11	0.16	0.14	0.12	0.10	0.098	0.095	0.076	0.067	0.059	0.054
C-C-M-M	0.14	0.21	0.11	0.17	0.078	-	-	-	-	-	0.071	0.045	0.036	0.024	0.018

*Calculating C factors not shown above: When soybeans replace corn, making two consecutive years of soybeans, *increase* the C factor 10 percent; when soybeans replace corn, making three consecutive years of soybeans, *increase* the C factor 15 percent. For each additional year of meadow, *decrease* the C factor 20 percent.

One pound of residue from crops such as small grain or soybeans is equivalent to 2 pounds of corn residue.

[a]Yearly average corn yield exceeds 75 bushels per acre, and legume grass yield exceeds 3.0 tons per acre. On soils where yields are below these averages, each C factor is to be increased 20 percent.

[b]For chisel planting, till-plant, and strip till systems in rotations containing meadow, the last year meadow was considered to be fall moldboard plowed before the first year row crop.

[c]C = corn; Sb = soybeans; G = small grain (wheat or oats); G_x = small grain with catch crop; M = meadow.

Source: Robert D. Walker and Robert A. Pope, Estimating Your Soil-Erosion Losses with the Universal Soil Equation, Cooperative Extension Service, University of Illinois, Urbana, Illinois, May, 1980.

Table B-4. Factor C for Permament Pasture, Range, and Idle Land[a]

Vegetative canopy		Cover that contacts the soil surface						
Type and height[b]	Percent cover[c]	Type[d]	Ground cover (percent) 0	20	40	60	80	95+
No appreciable canopy		G	0.45	0.20	0.10	0.042	0.013	0.003
		W	0.45	0.24	0.15	0.091	0.043	0.011
Tall weeds or short brush with average drop fall height of 20 in.	25	G	0.36	0.17	0.09	0.038	0.013	0.003
		W	0.36	0.20	0.13	0.083	0.041	0.011
	50	G	0.26	0.13	0.07	0.035	0.012	0.003
		W	0.26	0.16	0.11	0.076	0.039	0.011
	75	G	0.17	0.10	0.06	0.032	0.011	0.003
		W	0.17	0.12	0.09	0.068	0.038	0.011
Appreciable brush or bushes, with average drop fall height or 6.5 ft.	25	G	0.40	0.18	0.09	0.040	0.013	0.003
		W	0.40	0.22	0.14	0.087	0.042	0.011
	50	G	0.34	0.16	0.08	0.038	0.012	0.003
		W	0.34	0.19	0.13	0.082	0.041	0.011
	75	G	0.28	0.14	0.08	0.036	0.012	0.003
		W	0.28	0.17	0.12	0.078	0.040	0.011
Trees, but no appreciable low brush. Average drop fall height of 13 ft.	25	G	0.42	0.19	0.10	0.041	0.013	0.003
		W	0.42	0.23	0.14	0.089	0.042	0.011
	50	G	0.39	0.18	0.09	0.040	0.013	0.003
		W	0.39	0.21	0.14	0.087	0.042	0.011
	75	G	0.36	0.17	0.09	0.039	0.012	0.003
		W	0.36	0.20	0.13	0.084	0.041	0.011

[a]The listed C values assume that the vegetation and mulch are randomly distributed over the entire area.

[b]Canopy height is measured as the average fall height of water drops falling from the canopy to the ground. Canopy effect is inversely proportional to drop fall height and is negligible if fall height exceeds 33 ft.

[c]Portion of total-area surface that would be hidden from view by canopy in a vertical projection (a bird's-eye view).

[d]G: Cover at surface is grass, grasslike plants, decaying compacted duff, or litter at least 2 in. deep.

W: Cover at surface is mostly broadleaf herbaceous plants (as weeds with little lateral-root network near the surface) or undecayed residues or both.

Table B-5. Factor C for Undisturbed Forest Land

Area covered by canopy of trees and undergrowth (percent)	Area covered by duff at least 2 in. deep (percent)	C Factor[a]
100 to 75	100 to 90	0.0001 to 0.001
75 to 45	85 to 75	0.002 to 0.004
40 to 20	70 to 40	0.003 to 0.009

[a]The ranges in listed C values are caused by the ranges in the specified forest litter and canopy covers and by variations in effective canopy heights.

Source for above tables: Robert D. Walker and Robert A. Page, Estimating Your Soil-Erosion Losses with the Universal Soil Equation, Cooperative Extension Service, University of Illinois, Urbana, Illinois, May, 1980.

PERRY COUNTY SOIL ASSOCIATIONS
(USLE FACTORS FOR USE IN R.A.L. PROJECT)

Soil Association Area	Soil Series	Percent of Association	Individual K Values	Individual T Values	% x K	% xT	Composite K Value	Composite T Value
A	Cisne	65	.37	3	.24	1.95		
	Hoyleton	25	.37	3-2	.09	.63	.37	2.8
	Tamalco	(10)	.43	3-2	.04	.25		
B	Wynoose	40	.43	3	.17	1.20		
	Bluford	40	.43	3-2	.17	1.00	.43	2.9
	Ava	(20)	.43	4-3	.09	0.70		
C	Wagner	20	2.80	3	.06	0.60		
	Okaw	50	.43	3-2	.22	1.25		
	Hurst	(8)	.43	3-2	.03	0.20	.39	2.6
	Colp	15	.43	3-2	.06	0.38		
	Karnak	(7)	.32	3	.02	0.21		
D	Bluford	25	.43	3-2	.11	0.63		
	Ava	25	.43	4-3	.11	0.88		
	Blair	15	.43	3-2	.06	0.38	.41	3.5
	Hickory	(20)	.37	5-4	.07	0.90		
	Belknap	15	.37	5	.06	0.75		
E	Bluford	(8)	.43	3-2	.03	0.20		
	Ava	30	.43	4-3	.13	1.05		
	Blair	(7)	.43	3-2	.03	0.18	.40	4.0
	Hickory	40	.43	5-4	.15	1.80		
	Belknap	15	.37	5	.06	0.75		
F	Bonnie	65	.43	5	.28	3.25		
	Belknap	30	.37	5	.11	1.50	.41	5.0
	Sharon	(3)	.37	5	.01	0.15		
	Piopolis	(2)	.43	4	.01	0.08		

Source: Data compiled by Commission staff.

Appendix C

MINUTES OF THE AD HOC COMMITTEE ON RECLAIMED AGRICULTURAL LANDS

Membership of the Ad Hoc Committee on Reclaimed Agricultural Lands

Name	Representing
Robert Spencer	District Conservationist, Perry County Chairman U.S. Soil Conservation Service
Gary W. Raines	Reclamation Supervisor, Consolidation Coal Company
Ron Kiser	Reclamation Specialist, Consolidation Coal Company
Michael Platt	Division of Natural Resources, Illinois Department of Agriculture
Angela Kazakevicius	Division of Natural Resources, Illinois Department of Agriculture
James Pendowski	Planning Section, Illinois Environmental Protection Agency
Bob Basinger	Soil Conservation Service, Saline County Soil and Water Conservation District
Steven Verrechia	Southern Illinois University, Coal Research Center
Judy Gilter	Executive Director, Perry County Agricultural Stabilization and Conservation Service
Joe Fasig	Project Coordinator, Shawnee Resource Conservation and Development

GREATER EGYPT REGIONAL PLANNING AND DEVELOPMENT COMMISSION
CARBONDALE, ILLINOIS

MINUTES OF THE AD HOC COMMITTEE
ON RECLAIMED AGRICULTURAL LANDS MEETING
HELD JANUARY 18, 1982, at 1:00 P.M.
AT SOIL CONSERVATION SERVICE OFFICE,
PINCKNEYVILLE, ILLINOIS

Those present: Robert Spencer, Chairman (SCS); Gary Raines, Consol; Ron Kiser, Consol; Mike Platt, DNR, IDOA; Angela Kazakevicius, DNR; Jim Pendowski, IEPA; Bob Basinger, Saline Co. S&WCD; Steve Verrechia, SIU Coal Research Center; Judy Gilter, ASCS; Glenn Gill, GERPDC.

Absent: Joe Fasig, Shawnee RC&D.

Chairman Robert Spencer opened the meeting by reviewing the objectives of the project as presented in the work program and the draft report. He related them to the long range goals of the Perry County Soil and Water Conservation District.

Mr. Gill described the methods used in gathering data, making measurements on 1104 reclaimed lands and application of the Universal Soil Loss Equation. He explained data tables giving soil loss estimates for each area studied and the implications of the data for future concentration of row crop sequences in crop rotation plans. Thirteen hundred acres of reclaimed land in Perry County were represented in the data.

The Committee asked questions to clarify details of the project and discussed the implications of the data for soil management. The value of reduced tillage and terrace construction was discussed. Questions were asked to determine how erosion violations will be handled under the Illinois Sediment and Erosion Control Act. The development and use of Universal Soil Loss Equation factors was also discussed. Gary Raines indicated the hope that when reclaimed land returns to farming, rotations will include more years of meadow and less of row crops. The point was made that report tables could be used to indicate what rotation each area should be held to. Management problems were seen by the committee as most likely to appear after reclaimed areas return to private ownership.

Funding concepts and mechanisms were discussed briefly. The concensus of the committee was that, since the expected additional cost share money, sources may not be made available, the best avenue to assure proper management of reclaimed areas after they return to private ownership would be through cooperation with the Soil and Water Conservation District for conservation planning, use of high meadow rotations and seeking cost share money where needed through ASCS programs. Use of conservation tillage and tillage on the contour where terraces had been included in reclamation were seen as the most useful management practices.

There being no more business, the meeting was adjourned.